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*Technical Report—Phase II-a*

**ADAPTATIONS OF SCIENTISTS  
IN AN INDEPENDENT RESEARCH ORGANIZATION:  
A CASE STUDY**

*Prepared for:*

BEHAVIORAL SCIENCES DIVISION, AIR FORCE OFFICE OF SCIENTIFIC RESEARCH  
WASHINGTON, D.C.

CONTRACT NO. AF 49(638)-1028, TASK NO. 37707, PROJECT NO. 9

STANFORD RESEARCH INSTITUTE

MENLO PARK, CALIFORNIA

**\*SRI**

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May 1963

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SRI Project No. IMU-3580

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This research was supported by the  
Behavioral Sciences Division, AFOSR,  
SRLB  
under Contract/~~638~~ AF 49(638)-1028

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## I INTRODUCTION

In the recent popular sociological literature, authors have tended to portray modern man as a victim of social circumstances beyond his control. They see human individuality and creativity being swallowed up in large, complex organizational environments. Thus Vance Packard wrote in The Status Seekers:

The people of this country have become increasingly preoccupied with status primarily because of the impact on their lives of big housing developments, big advertisers, big trade unions, and big corporate hierarchies. As a result, democracy is still more of an ideal than a reality. The forces of the times seem to be conspiring to squeeze individuality and spontaneity from us.\*

William H. Whyte asked in The Organization Man:

. . . where is the boat going? No one seems to have the faintest idea; nor for that matter, do they see much point in even raising the question. Once people liked to think, at least, that they were in control of their destinies, but few of the younger organization people cherish such notions. Most see themselves as objects more acted upon than acting--and their future, therefore, determined as much by the system as by themselves.\*\*

C. Wright Mills claimed in his book, White Collar:

The twentieth century white collar man has never been independent as the farmer used to be, nor as hopeful of the main chance as the businessman. He is always somebody's man, the corporation's, the government's, the army's; and he is seen as the man who does not rise. The decline of the free entrepreneur and the rise of the dependent employee on the American

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\* Vance Packard, The Status Seekers (New York: David McKay, 1960), pp. 357-358.

\*\* William H. Whyte, The Organization Man (New York: Doubleday Anchor Books, 1956), p. 437.

scene has paralleled the decline of the independent individual and the rise of the little man in the American mind.\*

While these quotations certainly point to real dangers in modern organizational life, they do not necessarily provide a complete and balanced picture of what actually goes on in complex organizations. Individuals tend to develop ways and means to protect their autonomy and independence in the contexts where they are employed--at least where this is functional to the effective performance of professionalized occupational interests, as is the case among the research scientists in the independent research organization described herein.

Thus, organizations do indeed affect individuals, but this is not simply a one-way process. This report will show that individuals can, and do, act upon their organizational environments also.

The objective of the over-all research project of which the present study is a part is to analyze, systematically, interrelationships among (1) organizational requirements for the participation of research scientists in different organizational contexts, (2) perspectives of individual scientists toward this participation in different organizational contexts, and (3) adaptation mechanisms used (a) to integrate individual perspectives with organizational requirements, but also used (b) to reshape organizational requirements and goals in accord with individual interests of research personnel.

Phase II-a of this research project, summarized in this report, has consisted of an exploratory case study of adaptation mechanisms within one independent research organization, referred to as Tiros.\*\* The general purpose of this case study has been to develop areas of inquiry, substantive ideas, and techniques of measurement to be used in further study of adaptation mechanisms in other contexts. This study is being followed in Phase II-b by similar case studies of an industrial research laboratory, an academic research institute, a government laboratory, and another independent research organization. Later phases of the research will be directed toward determining (1) the extent to which generalizations can be extended from these exploratory case studies to larger populations of given types of research organizations and (2) the extent

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\* C. Wright Mills, White Collar (New York: Oxford Univ. Press, 1953), p. xii.

\*\* "The independent research organization studied."

to which these generalizations can be validated by before-and-after change studies in the same organizational contexts.

There are no completely new ideas; every so-called new idea, method of approach must build upon existing schools of thought and represent a synthesis of the ideas of others. This is certainly true of this research. The method of approach of Phase II-a of this study, as discussed in this report, represents a combination of (1) organizational analysis case studies, as practiced in the administrative sciences and sociology; (2) survey analysis methodology, as practiced in sociology and opinion research; (3) role theory, as practiced in social psychology based upon Meadian concepts; and (4) systems analysis methodology, as practiced in systems design and engineering activities.

The "natural systems" perspective of organizational analysis, as described in Chapter II of this report, was first introduced to me by Philip Selznick at the University of California. My understanding of this approach was also deepened by study under William Kornhauser and S. M. Lipset at the same institution. Hanan Selvin, Duncan MacRae, and Paul Wallin have all provided an education in survey analysis methodology, which we have attempted to apply here to the analysis of goals and processes within a single organizational context, rather than to a sample of respondents in a wider community or national population, as is usually done in sample surveys.

I was originally introduced to role theory (in a form derived mostly from the writings and teachings of George Herbert Mead) by Herbert Blumer and T. Shibutani at the University of California. I was recently reintroduced to its application to the understanding of adaptations of individual scientists in research organizations by Todd LaPorte, of the University of Southern California, who is collaborating on further phases of this research, in which we hope to utilize role theory more extensively.

Finally, I am indebted to my colleagues in the Systems Analysis Program at Stanford Research Institute--especially Albert Shapero, K. H. Schaeffer, and Charles Erickson--who introduced useful perspectives and techniques regarding input-output models, matrix methods for classification, and other concepts for relating human and non-human elements in a variety of complex systems. These ideas and techniques are all reflected at various points in this research.

In addition, I wish to express appreciation to Charles E. Hutchinson, Director of the Behavioral Sciences Division of the Air Force Office of Scientific Research, for suggestions and support in the conduct of this continuing research. At Stanford Research Institute, Gerrie Carpenter

rendered valuable assistance in the processing of data in connection with Phase II-a, and Robert Harker, William Pedersen, James Hacke, and Robert Dawson made valuable suggestions in connection with this technical report. Finally, I am indebted to the cooperation of the management and employees of Tiros, whose participation in this study made this report possible.

The case study reported herein is exploratory in nature. As explained earlier, it is being followed by comparable case studies. Therefore, we wish to avoid premature formalized generalizations before comparative analysis is completed. However, a model for the structure of formal generalizations that may be expected from this comparative analysis has been developed as part of Phase II-a, and is discussed in a separate working paper entitled "Structural-Functional Analysis as a Method."



## II MANAGERIAL REQUIREMENTS

This chapter provides a discussion of managerial requirements imposed upon research scientists at Tiros, the independent research organization which constitutes the immediate context for this particular case study. To understand these managerial requirements more fully in their broader socioeconomic and organizational context, particular attention is given to (1) the nature of the industry in which Tiros operates; (2) the goals and structure of Tiros--what it is attempting to accomplish within this industrial framework; (3) the implementation of goals--how these goals have been communicated to research personnel; and (4) specific managerial requirements--how these goals have been translated into particular organizational requirements in different parts of the organization.\*

Before investigating these matters, however, we shall turn briefly to a consideration of the perspective from which this analysis has been undertaken.

### Perspective of the Analysis

In a notable paper, Alvin Gouldner has described two fundamental models that have been used in the analysis of complex organizations.\*\* The first model, or method of approach, may be described as the rational-technical model of organizational analysis. Deriving most directly from the works of Max Weber, the method of approach essentially assumes that organizational goals are "given"--it concentrates attention upon what are conceived by participants in the organization to be rational means (e.g., a specified hierarchy of authority, a division of labor, and more or less formalized rules and regulations) utilized by an organization to achieve its stated goals.

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\* In this and the following chapters, the description of Tiros has been modified to preserve anonymity in instances where such modification does not affect the substance of the analysis.

\*\* Alvin W. Gouldner, "Organizational Analysis" in Sociology Today, edited by Robert K. Merton, Leonard Broom, and Leonard S. Cottrell, Jr. (New York: Basic Books, 1959), pp. 400-428.

A contrasting method of approach may be described as the natural-system model of organizational analysis. This approach, deriving ultimately from the works of August Comte and Robert Michels and exemplified more recently in studies of Philip Selznick, Robert Merton, and Talcott Parsons, concentrates attention on the way in which organizational goals are formulated, implemented, and modified over periods of time. From this perspective, organizations are viewed as dynamic and quasi-biological entities that develop a "life of their own," rather than simply as technical-mechanical entities for the achievement of externally defined objectives. Gouldner has written of this approach:

The organization, according to this model, strives to survive and to maintain its equilibrium, and thus striving may persist even after its explicitly held goals have been successfully attained. This strain toward survival may even on occasion lead to the neglect or distortion of the organization's goals. Whatever the plans of their creators, organizations, say the natural systems theorists, become ends in themselves and possess their own distinctive needs which have to be satisfied. Once established, organizations tend to generate new ends which constrain subsequent decisions.\*

Other writers, operating within the natural-system tradition, have pointed out that organizational goals are shaped and reshaped by coalitions of interest groups related in one way or another to organizational operations:

In an organization . . . there appears, in addition to the personal aims of the participants, an organization objective, or objectives. . . . The organization objective is, indirectly, a personal objective of all the participants. It is the means whereby their organizational activity is bound together to achieve satisfaction of their own diverse personal motives.\*\*

Let us conceive the organization as a coalition. It is a coalition of individuals, some of them organized into sub-coalitions. In the business organization, one immediately

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\* Ibid., p. 405.

\*\* Herbert Simon, Administrative Behavior (New York: Macmillan, 1954), p. 17.

thinks of such coalition members as managers, workers, stockholders, suppliers, customers, lawyers, tax collectors, etc. In the governmental organization, one thinks of such members as administrators, workers, appointive officials, elective officials, legislators, judges, clientele, etc. . . . This view of an organization as a coalition suggests, of course, several different recent treatments of organization theory in which a similar basic position is adopted. In particular, inducements-contributions theory (Barnard, Simon), theory of games (Von Neumann and Morgenstern), and theory of teams (Marschak).\*

Where organizations are viewed as coalitions of interest groups, a primary function of leadership can be seen as the achievement of agreement upon organizational purpose or goals among relevant interest groups.

A purpose does not incite cooperative activity unless it is accepted by those whose efforts will constitute the organization. . . . The inculcation of belief in the real existence of a common purpose is an essential executive function. It explains much educational and so-called morale work in political, industrial, and religious organizations that is so often otherwise inexplicable.\*\*

The aims of large organizations are often very broad. A certain vagueness must be accepted because it is difficult to foresee whether more specific goals will be realistic or wise. This situation presents the leader with one of his most difficult but indispensable tasks. He must specify and recast the general aims of his organization so as to adapt them, without serious corruption, to the requirements of institutional survival. . . . In defining the mission of the organization, leaders must take account of (1) the internal state of the polity: the strivings, inhibitions, and competences that exist within the organization; and (2) the external expectations that determine what must be sought or achieved if the institution is to survive.\*\*\*

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\* R. M. Cyert and J. G. March, "A Behavioral Theory of Organizational Objectives," in Modern Organization Theory, edited by Mason Haire (New York: Wiley, 1959), p. 78.

\*\* Chester Barnard, The Functions of the Executive (Cambridge, Mass.: Harvard Univ. Press, 1956), pp. 86-87.

\*\*\* Philip Selznick, Leadership in Administration (Evanston, Ill.: Row, Peterson, 1957), pp. 66-68.

This natural-system approach, rather than a rational-technical approach, is the predominant approach followed in this analysis of managerial requirements in Tiros. We shall examine the way in which the goals of Tiros have developed in a manner that attempts to accommodate different interest groups and the way in which management has sought to implement these goals through the structure of Tiros. This allows us, as Gouldner has pointed out, to pay particular attention to relatively spontaneous and unplanned (i.e., "informal") patterns of belief and action within a rationally planned organization.

Before examining internal matters, however, we shall follow Selznick's suggestion to examine external constraints that determine what must be sought or achieved by management for Tiros to survive.

### The Research Industry

Research and development activities in American industry as a whole have expanded tremendously in recent years. Their dollar volume has increased from about \$2 billion in 1945, to an estimated \$17.6 billion in 1963. During this time, basic, or fundamental, research activities have also increased to a \$2 billion effort in 1963. Most of this research and development effort (60.5%) represents federal government expenditures. Most of the federal government R&D expenditures (86%), in turn, support research and development establishments connected with industrial corporations (especially in such industries as aerospace and electronics) or with government agencies (especially in the defense departments).<sup>\*</sup> However, a proportionally small but increasing amount of government and industrial research and development funds are being spent in contracts with outside independent or semi-independent research organizations. These organizations include, at present, over 1,600 commercial profit-making laboratories and over 50 non-profit research institutes.<sup>\*\*</sup> These non-profit research institutes received almost \$90 million in research funds in 1957--51% of these funds coming from the federal government, 29% from industry, 11% from other sources, and 9% from self-generated

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\* Industrial Research, Vol. V (Jan. 1963), pp. 20-21.

\*\* National Science Foundation, Research and Development by Nonprofit Research Institutes and Commercial Laboratories, 1953 (Washington, D.C., GPO, NSF-56-15, 1956), p. 19.

in-house sources.\* According to a National Science Foundation study in 1953:

There is little distinction between the character, the history of their research activity, and the present function of non-profit institutes and that of the large commercial laboratories. Research and development by nonprofit research institutes appears to be a relatively new organizational idea in American life. Like the commercial laboratories, the institute type of organization was, in most instances, established to provide industry with a service, scientific in character, but pragmatically oriented toward solving business problems. Nor does there appear to be any difference in the type of scientific or administrative personnel employed on the research staffs of the two types of organizations.\*\*

This statement appears to be true today, ten years later, except for the fact indicated in later studies that many independent research organizations have become relatively more heavily involved in government-sponsored R&D activities. Many of these independent research and development organizations depend primarily upon the selling of R&D contracts for their livelihood--especially those that have little or no endowment support in connection with universities or foundations, on the one hand, and those that are not partially supported by hardware production in industrial corporations, on the other hand. They must live what some have characterized as a "hand-to-mouth existence," depending only upon their ingenuity in selling an R&D product in an increasingly competitive environment. Their environment is increasingly competitive not only because of increasing numbers of independent contract research establishments, but also because of the natural tendency for industrial firms and government agencies to eventually establish their own in-house R&D capabilities in technical fields that show sustained promise. Therefore, these independent research enterprises must keep in the forefront of new areas of scientific and technological advance in an age of accelerating technological change, so that their services remain in demand among the principal buyers of these services.

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\* National Science Foundation, "Reviews of Data on Research and Development," Research and Development Expenditures of Selected Groups of Nonprofit Institutions, 1957 (Washington, D.C., GPO: NSF-60-7, 1960), pp. 2-3.

\*\* National Science Foundation, Research and Development by Nonprofit Research Institutes and Commercial Laboratories, 1953, p. 1.

In sum, research and development has become a business in itself-- a business that requires an extremely farsighted, adaptable, and able management. Tiros is in this business.

#### The Formal Goals and Structure of Tiros

Like many of the independent contract research organizations described previously, Tiros was founded in the post-World War II period of accelerated national interest in research and development. Its formal purposes, as stated in its articles of incorporation, are as follows:

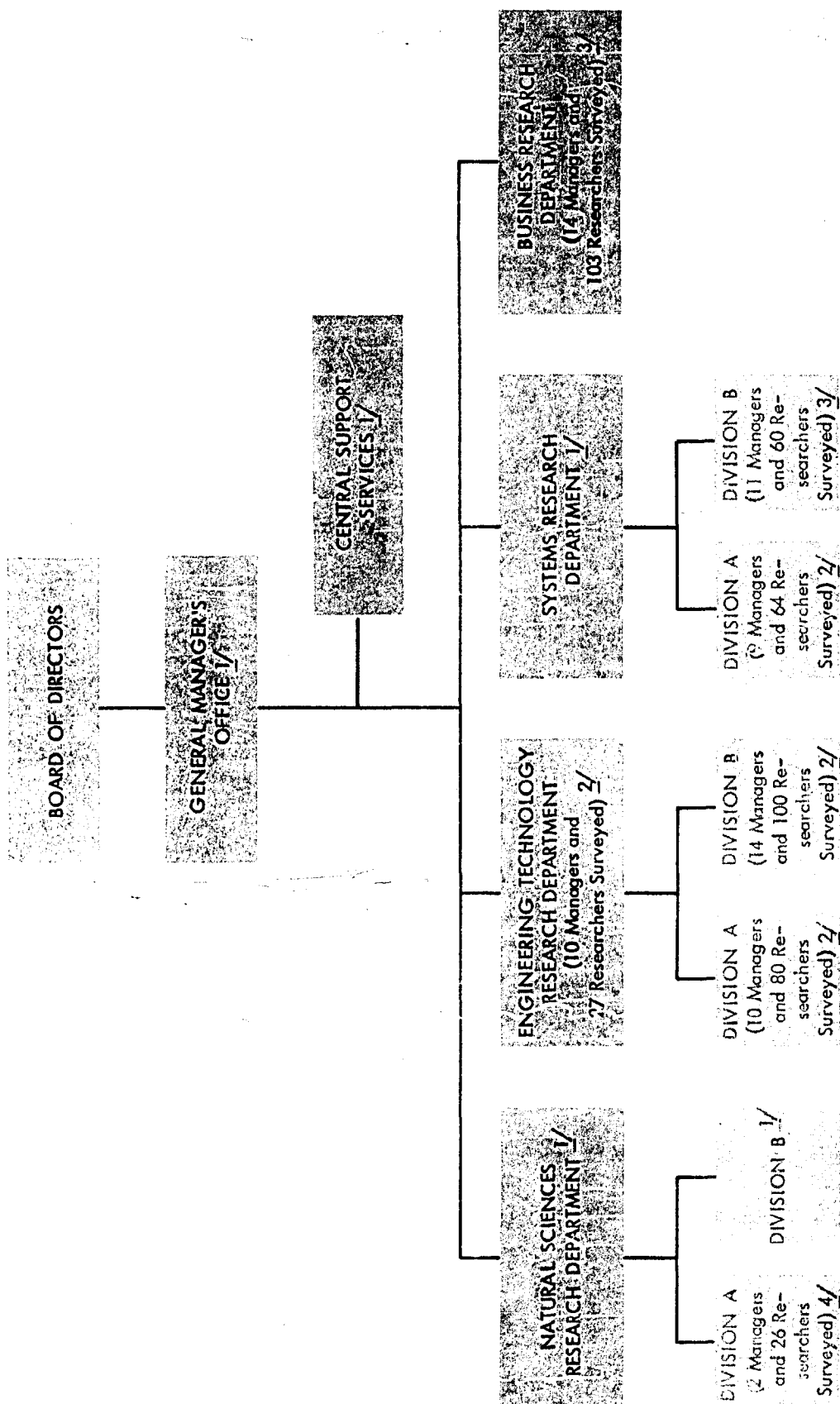
To conduct pure and applied research in the natural sciences, engineering, and management fields; to promote and enhance the application of science in the development of commerce and industry in the region; and to participate in the improvement of the general welfare of mankind.

As indicated in the above statement, Tiros was initially conceived by its founders, a group of leading industrialists, to be a research service facility to aid in the translation of scientific research findings into applications useful in the continued industrial development of their area. At the same time, the formal statement of purpose indicates a vagueness regarding the degree to which Tiros was primarily intended to be simply an applied research center or to be an organization where fundamental research is also undertaken to discover and develop scientific knowledge of ultimate use. In other words, the question was left unsettled as to whether Tiros was to be primarily responsive to immediate research problems posed by its clientele, or to be, at least in some sizable degree, responsive to more fundamental research problems generated by scientific interests. Moreover, even though the articles of incorporation indicate a special emphasis upon regional research problems, it may be noted that these articles left open the possibility that a considerable amount of research effort might also be devoted to problems of a wider range of clientele in "the improvement of the general welfare of mankind."

Throughout the years of its development up to the present time, the organizational structure of Tiros has reflected its major purpose of conducting research in the "natural sciences, engineering, and management fields." Its present organizational structure is shown schematically in Figure 1. There is a General Manager responsible to the Board of Directors of the corporation. Under the General Manager are four research departments and a central service staff. The Natural Sciences Research Department is supported by a combination of government contracts, industrial contracts, and research foundations. The department has two divisions. Two managers and 26 research scientists in one of these divisions participated in an initial interview study which served as a pre-test of

FIGURE 1

TIROS ORGANIZATION CHART SHOWING UNITS INCLUDED  
IN SURVEYS 1, 2, AND 3



1/ No individuals were surveyed in these units.

2/ Survey 3 also used a written questionnaire technique. Three researchers in Survey 3 did not indicate their organizational assignment.

3/ Survey 2 used a written questionnaire technique.

4/ Survey 1 used an interview technique.

methods used in the larger study described in this report. The Engineering Technology Research Department also consists of two divisions, which are essentially quite similar in nature and which both participated in an extensive questionnaire survey (Survey 3) as part of this research. Work in these divisions is supported both by government and by private industry. The Systems Research Department has been formed more recently than the other three departments. Its objective is to coordinate operations research activities from a multidisciplinary systems viewpoint, and it conducts research that is almost entirely sponsored by government defense agencies. One division in this department participated in the more extensive questionnaire survey, and another division participated in a less extensive questionnaire survey (Survey 2), but one that covered some of the same items included in the more extensive survey. Finally, the Business Research Department consists mostly of economists and business administration research specialists who work on problems of production planning, marketing, economic development, etc., and who are sponsored mostly by private industrial firms. Managerial and research personnel in this department, undifferentiated by division, participated in the more limited questionnaire survey (Survey 2).

Tiros grew rather rapidly in the earlier years of its existence. As is shown in Table I this growth, in terms of personnel, numbers of research projects, and dollar revenue from research projects, has continued generally, but at a slower rate, in more recent years. Except for dollar revenue, which has increased continually, there was a temporary decrease in growth during a business recession in 1956 and another very slight decrease (in total personnel only) during another business recession in 1959. During the 1950's and up to the present, there has also been a general increase in the average size of the research projects undertaken at Tiros and an increase in the proportion of government-sponsored projects, especially during the Korean war and in more recent years since 1958.

In the opinion of some managers at Tiros, these growth trends have made possible some shift in emphasis in Tiros research activities. One manager expressed this shift in the following terms:

(The principal goal of Tiros) started out to be performing research for other organizations unable to support their own research activities. Now there seems to be a mixed goal--expansion of Tiros itself and conducting specialized research under government sponsorship.

More explicitly, it may be said that the formal goals of Tiros have always been (1) to provide research services oriented specifically to



Table I

INDICATORS OF ORGANIZATIONAL GROWTH

<u>Year</u>	<u>Percent Increase in Total Personnel</u>	<u>Percent Increase in Number of Research Projects</u>	<u>Percent Increase in Dollar Revenue from Research Projects</u>	<u>Average Size of Research Projects (000's of \$)</u>	<u>Percent Research Revenue from Gov- ernment Sources</u>
1950	9%	46%	16%	\$11.2	27%
1951	55	21	76	21.1	49
1952	26	89	26	11.7	52
1953	30	-2	15	14.9	46
1954	39	21	36	16.2	42
1955	26	23	33	16.8	41
1956	-2	-6	22	15.7	46
1957	19	-2	17	22.0	47
1958	14	37	21	25.9	53
1959	-2	9	26	31.7	54
1960	18	12	10	30.1	55
1961	5	11	1	29.8	57

the immediate needs of research clients and (2) to conduct fundamental scientific research of high quality in areas of ultimate use to mankind. Added to these service and technical objectives is a third objective, institutional in nature: to provide for the survival and reasonable growth of Tiros itself. This survival goal, as organizational theorists have pointed out, is certainly present, in a greater or lesser degree, in all institutions.

At Tiros, however, there is some evidence to suggest that the institutional and technical goals of the organization have become more prominent and more emphasized in addition to the service goal in recent years. Three circumstances may have contributed to this shift in emphasis:

(1) increasing competitiveness among independent research organizations, as mentioned earlier, which has apparently contributed to a growing concern with institutional survival in many, if not all, independent research organizations; (2) increasing dependence upon research contracts with government agencies rather than private industrial firms, along with an increase in the average size of research contracts that apparently exceeds any increasing cost of conducting research--this in turn may allow more basic or fundamental research within the context of larger applied research contracts;\* and (3) increasing availability of funds, especially from government agencies and from research foundations, to support basic research primarily oriented toward fundamental scientific interests rather than immediate practical problems of business or government--this has also permitted a number of scientists to conduct research explicitly defined as basic or fundamental in character within the context of Tiros.

#### Implementation of Goals at Tiros

As suggested previously, goals become implemented in an organization to the degree that they become explicitly recognized and acted upon by various interest groups connected with the organization. In order to make at least a partial assessment of the degree to which the three aforementioned categories of goals--institutional, technical, and service--have become implemented in the day-to-day operations of Tiros, the following two open-ended questions were asked of personnel in the two Engineering Technology divisions and Division A of the Systems Research Department in the third survey: "What do you feel is the single most important goal of Tiros--that is, the most important consideration

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\* This topic is discussed further in chapter VIII.

influencing management decisions at Tiros?" and "What do you feel is the second most important goal of Tiros?" Responses to these two questions were then classified as primarily related to institutional, technical, or service goals. Following are examples of responses classified as institutional in character:

(The single most important goal of Tiros) appears to be "to stay in the black" financially and to enhance the "public image" of Tiros.

Determination of the role Tiros is to play over the long term in the research world.

Keeping at the top in its field.

Survival and financial growth.

To be viable and healthy with a high assurance of continuity.

To make Tiros a good place for scientists and engineers to work.

Other responses, such as the following, were classified as technical in nature:

(The single most important goal of Tiros) is doing good scientific work.

Quality of product.

Accomplishment of important scientific objectives.

To do an excellent technical job on any project undertaken.

To keep our projects in the frontiers of science.

Selection and support of proper areas for research activity at Tiros and ensuring the highest possible standards in the areas of endeavor selected.

Showing more concern for good research products than for expansion plans and public relations.

Still other responses, such as the following, were classified as service goals:

(The single most important goal of Tiros) is providing a high quality research service to industry and government.

To do useful research.

To provide research services in the interest of national defense.

To develop solutions to problems contributing to the welfare of the client, the nation, or mankind in general.

To conduct as much research as we can afford in the public interest.

To satisfy clients regarding their problems in the applied research field.

To apply Tiros breadth of capabilities to problems of great national and international significance.

How much has each one of these goals been implemented among Tiros personnel?--What is their relative potency among Tiros personnel?--Among different categories of personnel?

Table II shows that larger proportions of all managerial personnel and of all research personnel asked this question indicated that institutional goals were of greater importance in comparison with the proportions who mentioned other goal categories. This finding reflects what Selznick has claimed to be a primary function of leadership in any organization--the specification and recasting of the aims of the organization in order to adapt them, without serious corruption, to the requirements of institutional survival. At the same time, some managerial personnel have been concerned lest institutional considerations at Tiros obscure what they consider to be more fundamental goals, as the following comment of a Tiros manager in the Natural Sciences Department indicates:

It has often appeared that Tiros was evaluating its own success in terms of its size and the magnitude of its annual business. I believe this is a mistake resulting from its competitive business situation. Financial solvency should be the first constraint under which we operate, but not the goal of Tiros.

This individual continued to suggest that the primary goals of Tiros should be public benefit and research quality in relation to general scientific knowledge. Research personnel in other divisions have voiced the same complaint in the following terms:

Table II

**GOALS OF TIROS AS PERCEIVED BY MANAGERIAL AND  
RESEARCH PERSONNEL IN THREE DIVISIONS<sup>a</sup>**

	<u>Proportion of Personnel Indicating:</u>			
	<u>Institu- tional Goal<sup>b</sup></u>	<u>Technical Goal<sup>c</sup></u>	<u>Service Goal<sup>d</sup></u>	<u>No Answer or Not Classi- fiable</u>
<b>Managerial personnel</b>				
Engineering Division A (N = 10)	40%	30%	20%	10%
Engineering Division B (N = 14)	50	28	14	7
Systems Division A (N = 9)	33	44	0	22
All managerial personnel in Survey 3 (N = 42)	48	26	14	12
<b>Research personnel</b>				
Engineering Division A (N = 80)	47	32	9	12
Engineering Division B (N = 100)	45	30	10	15
Systems Division A (N = 64)	27	25	22	27
All research personnel in Survey 3 (N = 271)	41	27	12	20

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- a. These data were collected and categorized from responses to the following question on the Survey 3 questionnaire: "What do you feel is the single most important goal of Tiros--that is, the most important consideration influencing management decisions at Tiros?"
- b. Institutional goals refer to considerations primarily connected with the maintenance and survival of Tiros itself.
- c. Technical goals refer to the scientific and technical quality of the research performed.
- d. Service goals refer to the character of the service provided to research clients.

The greatest problem in Tiros' research activities is that these activities are determined too much by the criterion "Can we get somebody to pay for it?" and not enough by the criterion "Is this an important area of research?" Importance means making a contribution to science or to the welfare of mankind directly. But I see no solution to this problem.

Occasionally in the past there has existed on our part a slight tendency to accept projects independently of our judgment of their value to the client and to Tiros. We should keep in mind that, while making money is important, it is much more important to do good research. Thus, we should be prepared to reject a project occasionally on the grounds that while it would make dollars, it doesn't make sense.

We should take the emphasis away from selling contracts and making profits, and put it back on doing an outstanding technical job.

Certainly, as indicated in Table II, technical goals tend to receive an emphasis second in frequency to institutional goals among both the managerial and research personnel surveyed, with service goals placing third in frequency of mention. However, the increasingly competitive position of Tiros in the research industry appears, in part at least, to have caused primary emphasis to be placed upon institutional survival. It is perhaps of significance to note that managers in Systems Division A were least likely to emphasize institutional considerations as factors in managerial decision-making; this is one of the two Systems Research divisions that are most supported by research funds from government sources and that, therefore, are least plagued by the financial survival worries that concern other divisions that are more dependent upon steady support from private industrial sources.

In general it may be said, however, that there is little variability in the pattern of ranking of goals at Tiros among the different managerial and research personnel surveyed. Although there are no comparable data for other parts of Tiros not surveyed on this matter, there is some reason to expect, from the nature of the research performed, that the Natural Sciences personnel might tend to place more emphasis upon technical goals than in the other divisions and that the Business Research personnel would probably place more emphasis upon service goals. Thus, by organizing itself into the four departments shown in Figure 1, Tiros

appears to have at least partly accommodated itself to all three categories of goals suggested in its articles of incorporation. It appears, indeed, to represent a coalition of basic interests.

At the same time, however, it should be pointed out that the emphasis upon at least three categories of goals at Tiros causes some confusion and ambiguity in the minds of many Tiros staff members. No single goal has become formalized or thoroughly implemented throughout the organization. This situation is indicated by the following comments written on questionnaires by Tiros staff members, many of whom feel that there should be clearer definitions of organizational objectives:

Very seldom, if at all, can you find agreement within the staff as to Tiros' objectives and methods of accomplishment.

We should decide what type of research organization this is to be. What types of research are we to specialize in? What types are we to reject? What are to be the criteria for new research program selection?

Tiros should establish and make known to its professional personnel the long range plans for Tiros. What kind of organization do we want to be?

We need to have more clearly defined objectives and policies.

Related to the desire among many staff members for more clearly defined goals is an expressed desire among some for more centralized authority:

Tiros could use considerable "pulling together" at the top and a greater level of understanding and cooperation between divisions.

Tiros could greatly improve in terms of a more clear delineation of responsibilities for supervision of research and the allocation of research tasks to the various parts of the organization.

Management should try to create greater unity within Tiros. Too often Tiros gives the impression of being a merchandise mart of research shops coordinated by cost accountants.

Management could develop policy guidance and exercise more positive control of research activities of the divisions to reduce competition, to exercise quality control to maintain high standards, and to encourage research personnel who are doing high quality work.

On the other hand, a sizable number of Tiros personnel apparently recognize that some degree of goal ambiguity and lack of clear cut assignment of responsibilities within the organizational structure is functional to the flexibility of the organization itself. In terms of Selznick's analysis of organizations, these people may be said to recognize, at least implicitly, the dangers of premature goal definitions within any organizational coalition.\* They appear to recognize the need for a considerable degree of decentralization in policy decisions within a research organization that attempts, in part at least, to produce contributions to basic scientific knowledge. At Tiros, such individuals tend to complain about too much centralization of authority:

The organization of Tiros has become too pyramided, I feel. . . . One effect has been that many people with managerial responsibility have become far removed from performing the *raison d'être* function of Tiros--contract research.

There needs to be a major decentralization along lines of functional research involving both fiscal matters and the locus of policy decisions.

We should avoid centralization of research management and limit the "integrating" functions and "interpretation" of research to a less dominant position.

We should have scientific objectives for Tiros established by scientists, and project quality monitored by scientists, not by administrators.

Therefore, it appears that the major leadership function of management at Tiros is to maintain a delicate and somewhat precarious balance between perceived organizational needs for purpose, direction, and coordination of effort, on the one hand, and for flexibility, freedom, and accommodation to diverse primary interests in both the external and internal environment of the organization, on the other hand.

#### Specific Managerial Requirements

As mentioned earlier, the delicate balance between diverse research goals and interests at Tiros has been maintained, in part, by differences

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\* Selznick, op. cit., pp. 68-74.



in emphasis between various research departments and divisions at Tiros. The extent of this diversity, ranging between an almost complete emphasis upon applied research oriented toward client service considerations in the Business Research Department and the two Systems Research divisions to an equal emphasis upon both basic and applied research considerations in the Engineering Technology divisions, is demonstrated in Table III. This table shows both (1) the proportions of managers in each division who indicated that applied research and basic research should be considered as "extremely important" among research personnel and (2) an index of total managerial emphasis on each kind of research in each division. Although strictly comparable data on these matters are lacking for the Natural Sciences division studied, there is some evidence to indicate that the natural scientists at Tiros tend to place relatively more emphasis upon basic research than upon applied research.

These marked differences in the orientation of the different research divisions are reflected in the nature of the specific managerial requirements imposed upon research personnel. These managerial requirements are described in Figure 2. This figure was presented in the first technical report in this continuing research study.\* It shows, schematically, certain major processes that may exist, in greater or lesser degree, within any research organization or research department within a larger organizational context. These major processes include (1) acquisition process--funds acquisition, information acquisition, and personnel acquisition, which provide the necessary "raw material" for research activities; (2) production processes--research design, data collection, data manipulation, interpretation, and project resource management, which constitute the core of research activities; (3) transmission processes--technical report writing, publications writing, and implementation activities, which transform research activities into outputs useful to research clients, scientific colleagues, and the general public; and (4) administrative processes, which direct, allocate, and coordinate diverse activities within the research organization.

In Survey 3, managers were asked three questions which appertain especially to acquisition processes: (1) How important do you believe it should be to researchers at Tiros to sell research ideas to prospective clients: (that is, to solicit financial support for research

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\* H. M. Vollmer, A Preliminary Investigation and Analysis of the Role of Scientists in Research Organizations (Menlo Park, Calif.: Stanford Research Institute, a Phase I technical report to the Air Force Office of Scientific Research, 1962), p. 40.

Table III

MANAGERIAL EMPHASIS ON BASIC AND APPLIED RESEARCH  
ACTIVITIES IN FIVE DIVISIONS

	Proportion of Managers Indicating "Extremely Important"				
	Engineering Technology Division A (N = 10)	Engineering Technology Division B (N = 14)	Systems Research Division A (N = 9)	Systems Research Division B (N = 11)	Business Research Department (N = 14)
Opportunity to do research that contributes to scien- tific knowledge	70% <sup>a</sup> 170 <sup>b</sup>	64% 164	11% 111	45% 126	29% 108
Opportunity to do research that helps solve problems in industry or government	70% 170	64% 164	67% 189	82% 182	100% 200

Note: All data in this table are from Surveys 2 and 3.

- a. Percentage data show the proportion of managers in each division who indicated that the item should be considered to be "extremely important" among research personnel.
- b. These numbers are indexes of the total range of managers' responses on these items according to the following weighting scheme: the percentage who indicated that the item should be "extremely important" to research personnel was multiplied by 2; the percentage who indicated that the item should be considered "moderately important" was multiplied by 1; and the percentage who indicated that the item should be considered "not very important" was multiplied by zero. This index of emphasis, therefore, can vary between 200, where all managers indicate that the item should be considered "extremely important" among research personnel, and 0, where all managers indicate that the item should be considered "not very important."

Table III

MANAGERIAL EMPHASIS ON BASIC AND APPLIED RESEARCH  
ACTIVITIES IN FIVE DIVISIONS

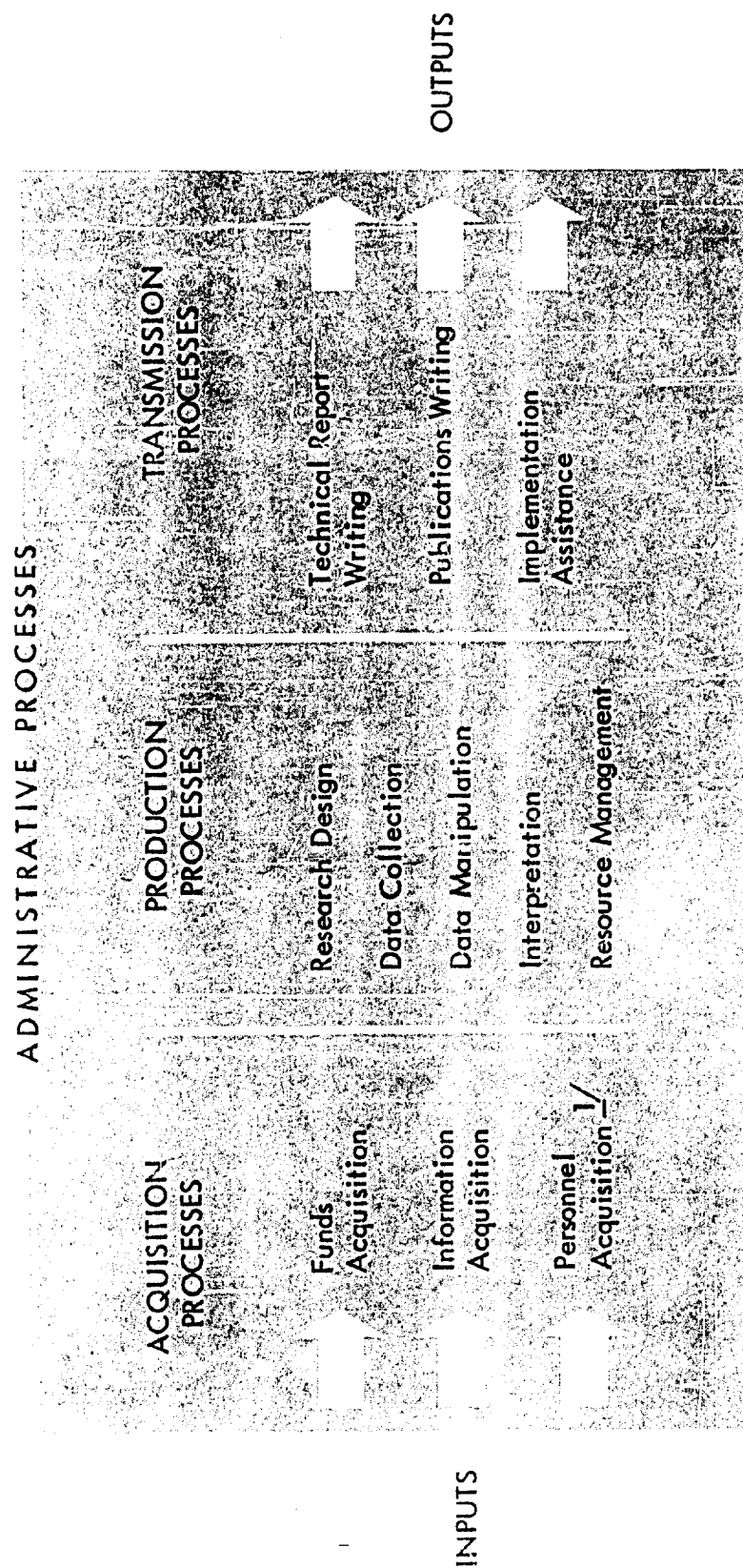
	Proportion of Managers Indicating "Extremely Important"				
	Engineering Technology Division A (N = 10)	Engineering Technology Division B (N = 14)	Systems Research Division A (N = 9)	Systems Research Division B (N = 11)	Business Research Department (N = 14)
Opportunity to do research that contributes to scientific knowledge	70% <sup>a</sup> 170 <sup>b</sup>	64% 164	11% 111	45% 126	29% 108
Opportunity to do research that helps solve problems in industry or government	70% 170	64% 164	67% 189	82% 182	100% 200

Note: All data in this table are from Surveys 2 and 3.

- a. Percentage data show the proportion of managers in each division who indicated that the item should be considered to be "extremely important" among research personnel.
- b. These numbers are indexes of the total range of managers' responses on these items according to the following weighting scheme: the percentage who indicated that the item should be "extremely important" to research personnel was multiplied by 2; the percentage who indicated that the item should be considered "moderately important" was multiplied by 1; and the percentage who indicated that the item should be considered "not very important" was multiplied by zero. This index of emphasis, therefore, can vary between 200, where all managers indicate that the item should be considered "extremely important" among research personnel, and 0, where all managers indicate that the item should be considered "not very important."

FIGURE 2

SCHEMATIC REPRESENTATION OF PROCESSES WITHIN  
A RESEARCH ORGANIZATION



<sup>1/</sup> Recruitment, selection; orientation and training; and motivation.

projects on their own); (2) How important do you believe it should be to researchers at Tiros to keep up-to-date on new scientific developments?; and (3) How important do you believe it should be to researchers at Tiros to be able to obtain an adequate staff of technical assistants?

Research scientists at Tiros have no formal responsibility for the acquisition of new personnel for the organization, but research scientists--especially those who are "project leaders" in charge of research projects--must be concerned with acquiring suitable personnel for their projects. Table IV shows that this is especially true in the Engineering Research Divisions; at the other extreme, Systems Division A is more likely to expect its personnel to work without as much technical support on systems studies.

Table IV also shows that research personnel in the divisions surveyed are not commonly required to participate directly in the process of seeking funds to support research activities. Nevertheless, research personnel in some parts of Tiros are certainly actively encouraged by management to exploit whatever contacts they may develop for outside research support. Table IV suggests that this may be the case more frequently in Engineering Division B, which may be slightly more oriented toward institutional goals (e.g., problems of organizational survival) than the other divisions shown in Table II. Although strictly comparable data are not available, there is nevertheless some evidence to indicate that there is at least as much emphasis upon individual fund-raising activities in the Business Research Department as in Engineering Division B. The Business Research Department also appears to be strongly institutional and service-oriented in its goals. Emphasis upon individual fund-raising activities among research personnel is least in Systems Research Division A, which already has the most ample and continuous level of funding of all the divisions because of large, long-run government contracts, and which therefore tends to be least concerned with institutional considerations.

Of all the managerial requirements shown in Table IV, the most emphasis was placed upon the responsibility of the individual researcher to keep up to date on new scientific developments related to his research field. This was especially true in the Engineering Technology divisions, which have a stronger orientation toward basic research.

As would be expected, Table IV shows that these same research divisions that are most oriented toward basic research (the Engineering divisions) also impose the strongest expectations that their personnel try to publish their research findings. Also as might be expected, there is less emphasis upon implementation than upon publication in those divisions

Table IV

MANAGERIAL EMPHASIS ON REQUIREMENTS FOR RESEARCH PERSONNEL  
IN THREE DIVISIONS

Requirement	Proportion of Managers Indicating "Extremely Important"			
	All Managerial Personnel in Three Divisions <sup>a</sup> (N = 42)	Engineering Technology Division A (N = 10)	Engineering Technology Division B (N = 14)	Systems Research Division A (N = 9)
<b>Developmental processes</b>				
Selling research ideas to prospective clients	14% <sup>b</sup> 92 <sup>b</sup>	10% 80	36% 122	0% 89
Keeping up-to-date on new scientific develop- ments	76% 176	70% 170	100% 200	44% 146
Having available an adequate staff for technical assistance	52% 144	70% 170	50% 150	33% 100
<b>Transmission processes</b>				
Publishing research findings in addition to Tiro's reports	50% 133	70% 160	57% 143	33% 99
Helping clients imple- ment Tiro's research	21% 104	20% 90	29% 129	33% 122
<b>Administrative processes</b>				
Exercising a large degree of freedom in choice of research assignments	57% 150	60% 160	79% 179	44% 121

Note: All data in this table are from Survey 3.

a. Includes 9 management personnel in the Engineering Technology Department offices.

b. For the interpretation of percentages and indexes, see footnotes to Table III  
(index can vary between 0 and 200).

where basic research is especially emphasized, and conversely, there is more emphasis upon implementation than upon publication in Systems Research Division A, which is oriented more toward applied research. Other data indicate similarly that there is more emphasis upon implementation in Systems Research Division B and the Business Research Department, whereas there is more emphasis upon publication in the Natural Sciences division. It is also probably compatible with a stronger orientation toward basic research for the Engineering Divisions to permit more freedom of choice in research assignments than the Systems Research division for which data were available on this item.

In addition to looking at managerial requirements with regard to various processes in a research organization, as is shown in Figure 2, one can also examine managerial requirements with regard to the career development of employees. For example: how much does management emphasize the importance of non-supervisory career ladders within a research field or profession in comparison with the emphasis placed upon career advancement into managerial positions? Table V shows that at Tiros, relatively more emphasis is placed upon the general expectation that research personnel should seek advancement within their own research field, rather than into management positions, which are limited in number in a flat organizational structure such as that at Tiros. In other words, Tiros management does not ordinarily expect its research personnel to become "organization men" seeking careers within the administrative structure of Tiros itself. However, an exception to this pattern is found in Systems Research Division A, where much more emphasis is placed upon the desirability of an organizational-managerial pattern of career aspirations in contrast to a professional pattern. It may be that this kind of managerial expectation with regard to career development is more compatible with the heavier emphasis upon applied research in this division; where basic research activities are given greater emphasis, it appears that emphasis on professional career development is more often the norm.\* As was pointed out previously, interests in basic research and applied research vary in different divisions within Tiros. Managerial emphasis upon organizational-managerial and professional career patterns vary in association with differences in the nature of the research activity within the organization.

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\* Evidence substantiating this conclusion from other studies is presented and discussed in detail in William Kornhauser, Scientists in Industry: Conflict and Accommodation (Berkeley and Los Angeles: University of California Press, 1962).

Table V

MANAGERIAL EMPHASIS ON REQUIREMENTS REGARDING  
CAREER DEVELOPMENT IN THREE DIVISIONS

Requirement	Proportion of Managers Indicating "Extremely Important"			
	All Managerial Personnel in Three Divisions (N = 42) <sup>a</sup>	Engineering Technology Division A (N = 10)	Engineering Technology Division B (N = 14)	Systems Research Division A (N = 9)
Seeking promotion within their re- search fields	50% <sup>b</sup> 143 <sup>b</sup>	50% 150	64% 164	44% 111
Seeking promotion into management positions at Tiros	19% 100	30% 70	14% 85	22% 122

Note: All data in this table are from Survey 3.

- a. Includes 9 management personnel in the Engineering Technology Department offices.
- b. For the interpretation of percentages and indexes, see the footnotes to Table III (index can vary between 0 and 200).

In summary, it may be said that the coexistence of three major organizational goals at Tiros--institutional, technical, and service--may be observed, from viewing the organization as a whole, to constitute a delicate balance between a coalition of interests within the organization. Internally, however, a differentiation of organizational structure into four major departments and several divisions within each department has occurred to segregate these interests, in part at least, and thereby to accommodate them within the total organizational structure. This differentiation of organizational structure, in turn, has resulted in quite



different kinds of organizational requirements for research scientists in the different divisions.

The degree to which the expectations and aspirations of research scientists are compatible, or in conflict, with these organizational requirements is discussed in the following chapter.

### III EMPLOYEE PERSPECTIVES

Conflict between individual goals and the goals of employing organizations has been an almost constant theme in reports of previous studies of scientists in different organizational contexts. For example, the Opinion Research Corporation reported from a study of six companies that the proportion of scientists and engineers who felt "there is a serious conflict between their personal goals and the goals of the organization for which they work" varied between 16% in one company up to 40% in another.\* A case study of a research department in a leading aerospace company, conducted by Todd LaPorte, has described how scientists in this organization tend to have technical goals and to emphasize an interest in basic research, whereas managers tend to have institutional goals and to emphasize applied research.\*\* William Kornhauser has reviewed a number of studies indicating that the aspirations and interests of scientists are more likely to deviate from organizational goals than those of engineers, pointing further to a difference in the general professional orientations of these two types of technical personnel.\*\*\*

Clark Kerr; Kornhauser, Dubin, and Ross; and other critics of certain assumptions in the "human relations" approach to industrial management have maintained that conflict between the basic interests of management (oriented toward institutional and organizational considerations) and of labor (oriented toward work group and individual aspirations) is not only inevitable, but indeed desirable, in a pluralistic society, as long as peaceful means can be used to achieve a mutual adjustment between these differences without a loss of productivity.† If it is true that

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\* Opinion Research Corporation, The Conflict between the Scientific Mind and the Management Mind (Princeton, N.J.: Opinion Research Corporation, 1959), pp. 3-4.

\*\* Todd LaPorte, "Career Goals and Role Orientations," (Stanford, Calif.: an unpublished Ph.D. dissertation in the Stanford University Library, 1963).

\*\*\* Kornhauser, op. cit., pp. 150-155.

† Clark Kerr, "Industrial Conflict and Its Mediation," American Journal of Sociology, Vol. LX (1954), pp. 230-245. Arthur Kornhauser, Robert Dubin, and Arthur Ross, eds., Industrial Conflict (New York: McGraw-Hill, 1954).

conflict between the basic interests of management and labor is at least a frequent, if not inevitable, aspect of relations between managers and manual workers, it appears to be even more true of relations between managers and scientists in many industrial laboratories. Inevitable or not, such conflict certainly poses a problem in relation to organizational effectiveness wherever it occurs.

In this chapter, the degree to which discrepancies between managerial requirements and employee interests exist at Tiros is examined; this examination is followed by a more detailed analysis of discrepancies between employee interests and experiences. Here we hope to get at what appear to be the most serious problems in the adaptation of individual research scientists to the organizational milieu at Tiros. This analysis will show that discrepancies between managerial requirements and employee interests may not constitute the only problem areas, or areas of conflict, in research organizations. There are other kinds of conflict that may be even more serious in relation to organizational effectiveness.

#### Employee Perspectives and Managerial Requirements--Publication

Table VI presents data summarized in the form of rating scores that show (1) the degree of emphasis placed upon each managerial requirement imposed upon research personnel at Tiros, as discussed in the previous chapter; (2) the degree of importance that Tiros management believes research personnel attach to each requirement; (3) the degree of importance that researchers actually attach to each requirement; and (4) the degree to which researchers believe that opportunity to fulfill the requirement has been provided at Tiros.\* As is shown again in Table VI (column A) and as was mentioned in the previous chapter, the management at Tiros generally lays greatest emphasis upon the requirements that individual research personnel should keep up-to-date on new scientific developments, exercise a large degree of freedom in research assignments, have an adequate staff of technical assistants available, and should attempt to publish research findings whenever possible. Table VI (columns C and F) indicates that the research personnel at Tiros are likely to agree with the management emphasis upon the need for an adequate technical staff, freedom in choice of research assignments, and keeping in touch with

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\* These rating scores are group or aggregate measures of the various topics indicated here.

Table VI

**DISCREPANCIES BETWEEN MANAGERIAL REQUIREMENTS, MANAGERIAL PERCEPTIONS OF  
THE IMPORTANCE OF REQUIREMENTS TO EMPLOYEES, THE ACTUAL IMPORTANCE  
OF REQUIREMENTS TO EMPLOYEES, AND THE EXPERIENCE OF  
EMPLOYEES WITH REGARD TO THESE REQUIREMENTS**

Requirement	Index							
	(A)	(B)	(C)	(D)	Discrepancy Indicators			
	Managerial Requirement Rating <sup>a</sup>	Managerial Perception Rating <sup>a</sup>	Employee Importance Rating <sup>a</sup>	Employee Experience Rating <sup>b</sup>	(E) (A)-(B)	(F) (A)-(C)	(G) (B)-(C)	(H) (C)-(D)
<b>Developmental processes</b>								
Selling research ideas to prospective clients	92	59	63	69	33	29	-4	-6
Keeping up-to-date on new scientific developments	176	140	160	93	36	16	-20	67
Having available an adequate staff for technical assistance	144	132	147	94	12	-3	-15	53
<b>Transmission processes</b>								
Publishing research findings in addition to Tiros reports	133	113	91	47	20	42	22	44
Helping clients implement Tiros research	104	59	84	50	45	20	-25	34
<b>Administrative processes</b>								
Exercising a large degree of freedom in choice of research assignments	150	143	135	64	7	15	8	71

Note: All data in this table are from Survey 3.

- a. The calculation of these indexes is explained in footnote b in Table III (indexes can vary between 0 and 200).  
b. The employee experience rating is an index of the total range of responses of professional research personnel according to the following weighting scheme: the percentage who indicated that they "definitely" had opportunity to perform the required task at Tiros was multiplied by 2, the percentage who answered simply "yes" was multiplied by 1, the percentage who said "no" was multiplied by 0, and the percentage who said "definitely not" was multiplied by -1 (index can vary between -100 and +200).

new scientific developments. However, there is much less emphasis upon publishing among these research personnel than would seem desirable to their management. This appears to be the most extensive area of management-employee conflict in emphasis at Tiros (column F).

Publishing research findings in respectable technical media is important at Tiros in that it contributes, at least indirectly, to all three goals of the organization. Thus, for example, publications not only enhance the professional reputation of the individual author, but they also enhance the technical reputation of Tiros as a place where outstanding research of publishable quality is undertaken. Publications also support the public service character of Tiros by making its research findings available to a wider audience than specific clients or sponsors of research contracts. Finally, publications support the continued life of the institution by making it easier to recruit additional scientific personnel of outstanding capability and to obtain additional funds to support its research endeavors.

However, management has recognized (Table VI, column B) that research personnel do not always place as much emphasis upon publication as they might, in part because of time pressures from project deadlines which allow only limited opportunity for writing technical papers or monographs in addition to project reports. Actually there is no institutionalized method for allocating time and funds for technical publication activity. Also, client confidentiality in some projects somewhat restricts opportunities to publish, as is indicated in the following comment by a Tiros Division Director to his employees:

The publication record of this division does not match our size and general reputation. We may be guilty of overstressing our policy of being willing to undertake confidential research, this to the detriment of disseminating our contributions in the professional literature. . . . The research methodology and, often, generalizations coming out of the study are in no sense proprietary or confidential. To the extent that we feel that they represent new findings, new undertakings, new methodology, we should publish. As I stated earlier, professional progress is heavily dependent upon the system of professional criticism and discussion which is afforded by publication. A very small percentage of our staff accounts for the major share of the publications of the division.

Actually, some research personnel at Tiros do publish the results of their research, and a few individuals have written many publications. Findings from Survey 3 in the present study have indicated that 6% of the

research staff included in this survey were authors of five or more publications in technical media based primarily upon Tiros research, 9% had written three or four publications, 10% had written two publications, and 12% had written one. However, 62% of the total research personnel included in Survey 3 had not written any publications based upon Tiros research. This appears to support the assertion that only a small percentage of the staff accounts for the major share of publications.

Research production pressures at Tiros that limit the availability of time and motivation to publish are indicated in the following statements by research personnel:

(The single most pressing problem or frustration I face in my job is) time to do all the little research jobs well.

--there are not enough hours in a day.

--interruptions, running out of time, and running out of money.

--being able to organize my time adequately to get all the things done that need doing, and in the proper order.

--too little time to give adequate thought to all the problems.

--insufficient time to pursue some investigations as completely as I would like.

--obtaining authority to spend sufficient time on a project or assignment to produce a high quality paper or report.

--there is little time to do research. The urgency of projects is too great. Often times a job requires collecting opinions, summarizing, and presenting them. Time for research leading to better solutions is not available.

Time pressures, such as those described above, are probably inherent in the structure of a research organization that is totally dependent upon the research contract system. There is constant pressure for research personnel within this system to keep active on project work directly chargeable to research contracts, rather than to spend indirect or overhead funds not directly chargeable to contracts. Table VII presents additional data showing that research production problems, most of which involve time pressures, constitute one of the most extensive

Table VII

**"MOST SERIOUS PROBLEM" AMONG MANAGERS AND RESEARCH PERSONNEL  
AND CROSS-PERCEPTIONS OF THESE PROBLEMS**

Problem	Proportion of Managers Indicating:		Proportion of Researchers Indicating:	
	Managers' Most Serious Problem (N = 42)	Research- ers' Most Serious Problem (N = 42)	Research- ers' Most Serious Problem (N = 271)	Managers' Most Serious Problem (N = 271)
Funds acquisition	36%	36%	20%	32%
Information acquisition	0	12	8	1
Personnel acquisition	2	0	6	8
Research production	5	14	21	4
Report writing	2	0	1	1
Publications writing	0	0	0	0
Implementation	0	0	0	0
Relations between manage- ment and subordinates	31	14	19	23
Relations with support services	7	10	4	7
Other; no response	<u>17</u>	<u>16</u>	<u>21</u>	<u>24</u>
	100%	100%	100%	100%

Note: All data in this table are from Survey 3.

problems among researchers at Tiros. Table VII also shows that these research production problems are less frequently experienced among Tiros managers, but some managers recognize that they are one of the more frequently-experienced frustrations among research personnel. Nevertheless, this recognition does not prevent managers from trying to get more publications from the research staff.

In sum, as is indicated in Table VI, Tiros management in general tends to favor a wider participation in publication writing among a staff that generally does not tend to place a comparable degree of emphasis upon it in the face of competing research requirements. In fact, data in Table VI (columns B, C, and G) suggest that management tends to underestimate the lower degree of emphasis that Tiros research personnel place upon the importance of publication--these research personnel actually place less emphasis upon it than many managers suppose.

The discrepancy between the requirement to publish and the lesser emphasis placed upon publication among researchers at Tiros constitutes one major discrepancy between managerial and employee interest within the organization. That Tiros is certainly not unique in this regard is shown by Todd LaPorte's finding that "publishing assumes the status of an obligation or duty for the scientist" in an aerospace research organization, which also strongly encourages publication efforts by its staff.\*

#### Employee Perspectives and Other Managerial Requirements

Table VI also shows that Tiros management tends to perceive that researchers place less emphasis upon the importance of keeping up to date on new scientific developments than they actually do (columns A, B, C, E, and F). Most researchers recognize this as being essential for preserving their job competency. There is little, if any, conflict between managerial requirements and employee interests on this item. On the other hand, there is a considerable discrepancy in the rated importance of this factor among the research personnel and the degree of opportunity they say they have actually had to keep in touch with new scientific developments (columns C, D, and H). Here again, it appears that the pressure of project deadlines over a long period of time may restrict opportunities for individual researchers to keep in close contact with outside scientific activity.

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\* LaPorte, op. cit.



The urgency of project obligations might be relieved, in part at least, by provision of more technical assistance in certain aspects of research activity, thus freeing research personnel for the more creative aspects of research planning, analysis, and interpretation which cannot be delegated to technical assistants. In the three Tiros divisions included in Survey 3, there are 52 technicians to 100 professional personnel. This compares very favorably, for example, to the number of technicians to professional research personnel in research functions in the average (median) aerospace company, which was only 19 in 1961.\* Nevertheless, Tiros' management and its research personnel have both recognized the desirability of more extensive technical assistance, and a sizable number of research personnel have reported that they do not have as much technical assistance at Tiros as they might desire (columns D and H).

Previous studies have indicated that scientific productivity in terms of publications is correlated with (1) freedom for the researcher to select his own research problems and (2) having larger amounts of funds available to the individual to support his own research interests.\*\* At Tiros, individuals who can raise sufficient funds to support their own individual research interests can thereby engage in preferred research under their own direction; those who cannot develop their own sources of individual project support must work on larger projects under the direction of other individuals. Therefore, there appears to be some ambiguity in the relatively low level of management emphasis upon selling research ideas to prospective clients (and an even lower degree of emphasis among researchers), in contrast to the high degree of managerial and researcher emphasis upon the importance of individual freedom in the choice of research assignments (Table VI, columns A and C). In short, most Tiros researchers want to have a lot of freedom of choice in their research assignments, but a smaller number are willing or able to develop necessary financial support for this freedom in the Tiros context--that is, by becoming "research entrepreneurs."

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\* From A. Shapero and H. M. Vollmer, "Technical Profile of the Industry" in The Industry-Government Aerospace Relationship (Menlo Park, Calif.: a report to the Aerospace Industries Association of America, Inc., 1963), Table H-9. This study indicates that some aerospace companies have as many as 128 technicians to 100 research personnel in their research activities.

\*\* Leo Meltzer, "Scientific Productivity in Organizational Settings," Journal of Social Issues, Vol. 12 (1956), pp. 542-549.

Table VII shows supporting evidence that acquiring funds to support the kinds of research most interesting to researchers is often recognized by researchers and management at Tiros as a serious and frustrating problem, as expressed in the following typical comments:

(The single most pressing problem or frustration I face is) finding financial support for the kind of work I would like to do.

--lack of support for my ideas by the U.S. government and Tiros.

--not having sufficient financial support for our technical programs.

--keeping Tiros on a sound financial footing in the face of fluctuations in the general economy.

--ensuring continuity of support of research programs.

--insufficient support for research in which I am strongly interested and insufficient support for the writing of technical papers for publication.

In addition, a large share of researchers' comments on "relations with management," as shown in Table VII, involved complaints about assignment to research tasks not directly within the line of interests of the researcher, and many of these complaints, in turn, are related to limitations in funding:

(The single most pressing problem or frustration I face is) being assigned to work outside my field which I am not particularly interested in--at least on a long-time basis.

--periods when there is little interesting work available for me.

--the project on which you are working is often discussed at higher levels and decisions are made without the researcher being given the opportunity to express his views or participate in the discussion.

--no management support--as a project leader I must promote and sell research, coordinate work with other departments, staff projects, find equipment, etc.

Thus, it appears that Tiros management seeks to implement the goals of the organization by instilling a motivation or inclination in researchers to maintain a high level of scientific productivity by keeping

in touch with new scientific developments, on one hand, and by contributing to general scientific knowledge through publication, on the other hand. At the same time, it appears that the environment of Tiros itself has limited the development of a motivation to publish. Its financial support structure (the research contract system) does not provide the degree of freedom that managers and researchers both desire to develop projects of most interest to individuals--which, in turn, provides the most opportunity for scientific productivity.

These conclusions are supported further by an analysis of conditions in different divisions within Tiros. In this regard, Table VIII shows that the managements in the two Engineering Technology divisions studied in Survey 3 both place a higher degree of emphasis upon freedom of choice in research assignments than the management in Systems Research Division A. (The nature of the large systems analysis contracts in this division restricts individual flexibility in project assignments.) Also, management in the Engineering Technology divisions tends to place more emphasis upon the desirability of individual publication of research findings in addition to Tiros reports. These differences in managerial requirements in the three divisions, in turn, are generally paralleled by different degrees of employee emphasis in the importance of freedom of choice and publication of findings. They are paralleled even more by differences in the degree to which employees in the three divisions have experienced an opportunity to exercise freedom of choice and to publish. Finally, it may be seen in Table VIII that the actual extent of publication among employees in these three divisions is strongly associated with the degree of freedom of choice that they have been allowed.

It may also be noticed in Table VIII that, although research personnel in Systems Research Division A were not generally as interested in freedom of choice and opportunity to publish as the research engineers in the other two divisions, the degree of discrepancy between (1) the level of interest in freedom of choice and in publication and (2) the perceived opportunity to publish that did exist among the Systems Research Division A personnel was much greater than in the Engineering Technology divisions, and in Engineering Technology B was greater than in Engineering Technology Division A. Therefore, Tiros research personnel do not seem to be completely adapted to different managerial requirements and emphases based upon different conditions within Tiros.

#### Employee Interests and Experiences

Another way of viewing some of the factors discussed previously is to examine them within a broad range of employee interests and experiences.

Table VIII

**MANAGERIAL REQUIREMENTS REGARDING PUBLICATION OF RESEARCH FINDINGS AND  
FREEDOM OF CHOICE IN RESEARCH ASSIGNMENTS, THE IMPORTANCE OF THESE  
REQUIREMENTS TO EMPLOYEES, THE EXPERIENCE OF EMPLOYEES WITH REGARD  
TO THESE REQUIREMENTS, AND PUBLICATION RATES IN THREE DIVISIONS**

	<u>Engineering Technology Division A</u>	<u>Engineering Technology Division B</u>	<u>Systems Research Division A</u>
<b>Managerial requirement rating on:</b>			
Exercising a large degree of freedom in choice of research assignments <sup>a</sup>	160	179	121
Publishing research findings in addition to Tiroc reports <sup>a</sup>	160	143	99
<b>Employee importance rating on:</b>			
Exercising a large degree of freedom in choice of research assignments <sup>a</sup>	149	140	118
Publishing research findings in addition to Tiroc reports <sup>a</sup>	102	95	80
<b>Employee experience rating on having adequate opportunity for:</b>			
Exercising a large degree of freedom in choice of research assignments <sup>b</sup>	96	68	27
Publishing research findings in addition to Tiroc reports <sup>b</sup>	100	45	3
Proportion of employees who have written one or more publications based upon research at Tiroc	58%	38%	16%
<b><u>Discrepancy between employee importance ratings and employee experience ratings</u></b>			
Exercising a large degree of freedom in choice of research assignments	53	72	91
Publishing research findings in addition to Tiroc reports	2	50	77

**Note:** All data in this table are from Survey 3.

- a. For the calculation of these indexes see footnote b in Table III (index can vary between 0 and 200).  
b. For the calculation of these indexes see footnote b in Table VI (index can vary between -100 and +200).

Thus, "exercising a large degree of freedom in research assignments" can be viewed either as a managerial requirement imposed upon research personnel or as an aspiration or expectation among research personnel regarding the context in which they are employed. The same might be said of "keeping up-to-date on new scientific developments," "having available adequate technical assistance," "having opportunity to publish research findings," "helping clients implement research findings," and "selling research ideas to prospective clients." There are also other interests that may be of greater or lesser importance to researchers. In this section, a wide variety of such interests among Tiros research personnel and the degree to which these interests have been satisfied at Tiros are discussed.

Table IX presents data indicating that the factor most frequently rated highly among Tiros research personnel is "opportunity to do research that is challenging." This corresponds to findings from previous studies, such as a study of 276 nonsupervisory scientists and engineers in ten companies conducted by John W. Riegel of the University of Michigan, which also reported that "challenge by projects assigned to me" was of most concern among these personnel.\* It is to be noted that this item is of high interest to more research personnel than such matters as salaries, promotional opportunities, or personal prestige (recognition by name) connected with their work. This implies that research personnel are generally more motivated by the nature of the work they are undertaking than by secondary awards attached to their work, and suggests the kind of incentives most effective to stimulate their productivity. Further analysis of the use of various incentives by management is described in the following chapter.

It was mentioned earlier that "opportunity to keep up-to-date on new scientific developments" and "having available adequate technical assistance" are both emphasized highly among most researchers at Tiros. Salary considerations were rated only slightly below these two factors in total emphasis, as is shown in Table IX. Also it was mentioned earlier that having sufficient funds available to do preferred research and having a large degree of freedom in selecting research assignments were both rated important and are probably interrelated with each other in the Tiros context.

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\* John W. Riegel, Administration of Salaries and Intangible Rewards for Engineers and Scientists (Ann Arbor, Mich.: Univ. of Michigan, Bureau of Industrial Relations, 1958), Part II, p. 27.

Table IX

**IMPORTANCE ATTACHED TO VARIOUS WORKING CONDITIONS AND  
EXPERIENCE OF THESE CONDITIONS AMONG RESEARCH PERSONNEL**

Condition	Index		Discrepancy (A) - (B)
	(A) Employee Importance Rating <sup>a</sup>	(B) Employee Experience Rating <sup>b</sup>	
Opportunity to do research that is challenging	177	145	32
Opportunity to keep up-to-date on new scientific developments in my field	160	93	67
Having available adequate technical assistance	147	94	53
Having an adequate salary	140	92	48
Having sufficient funds available to conduct the kind of research I want to do	138	54	84
Opportunity to do research that contributes to scientific knowledge	138	85	53
Being employed by an organization which is highly regarded by research people in my field	137	146	-9
Having a large degree of freedom in selecting research projects to work on	135	64	71
Opportunity to do research that helps solve problems in industry or government	135	144	-9
Opportunity for promotion within my research field	127	101	26
Opportunity to do interdisciplinary research with researchers of different academic backgrounds	105	105	0
General recognition of individuals by name in connection with Tiros research	95	87	8
Opportunity to write up and publish research findings in addition to Tiros reports	91	47	44
Opportunity to help clients implement Tiros research	84	50	34
Opportunity for promotion into supervisory or management positions at Tiros	83	65	18
Opportunity to sell research ideas to prospective clients	63	69	-6

Note: All data in this table are from Survey 3.

- a. For the calculation of these indexes see footnote b to Table III (index can vary between 0 and 200).
- b. For the calculation of these indexes see footnote b to Table VI (index can vary between -100 and +200).

Opportunity to do research that contributes to scientific knowledge (basic research) was rated important among a slightly higher proportion of researchers than opportunity to do research that helps solve problems in industry or government (applied research). Being employed by an organization with a good reputation among research people in one's field was rated important almost as frequently as opportunity to do basic research.

Opportunity for promotion within one's own research field was rated important more frequently than opportunity for promotion into management positions, which is probably in accord with the fact that there are relatively few management positions and thus few opportunities for promotion into them at Tiros.

Although Tiros stresses its interdisciplinary research activities, the research personnel surveyed in Survey 3 do not indicate an especially high degree of interest in interdisciplinary research. Many would probably be just as content to stay within familiar disciplines and fields of activity.

Emphasis upon the importance of recognizing individuals by name in connection with their research outputs was also not indicated as frequently, probably because this recognition is generally given at Tiros, at least for personnel who make major project contributions.

As was pointed out earlier, most Tiros research personnel do not give much emphasis to publication of research findings, or to implementation of research among clients, and tend to place the least importance upon opportunities to sell research ideas to prospective clients. Yet, paradoxically, this is perhaps the most effective way for individuals at Tiros to obtain control of research funds to support their own interests and thus be able to exercise a large degree of freedom in selecting research problems to work on. An analysis of "research entrepreneurship" in this regard is presented in Chapter VII.

Table IX also shows that employee desires for having sufficient research funds to support their own research interests, freedom in project assignments, and keeping in touch with new scientific developments were least likely to be met by the working conditions provided at Tiros.

#### Conflict Problems at Tiros

Thus, from comparing the degree to which these interests have been satisfied with the degree to which a wide variety of other employee

interests have been satisfied, and from examining managerial requirements reported earlier, one is led to the general conclusion that funds acquisition, information acquisition, project assignment, and publications production represent four major "problem areas" at Tiros.

These are "problems" for different reasons, however. Increasing the rate of technical publication is a problem because it involves a general discrepancy between managerial requirements and employee interests. It is a management-employee conflict problem like those referred to earlier in the writings of Clark Kerr and Kornhauser, Dubin, and Ross. Problems connected with information acquisition and with project assignment, on the other hand, do not represent management-employee conflicts at Tiros. Both managers and research personnel generally recognize the importance of keeping up to date on new scientific developments and allowing a maximum degree of freedom in project assignments, but the Tiros research funding structure (the research contract system) and related project work loads and time pressures do not permit the degree of freedom in research assignments and the opportunity to keep in touch with scientific information sources that employees and managers both desire. These, then, may be said to constitute structural conflict problems. Finally, it appears that obtaining funds to support the kind of research in which individuals are most interested is recognized as a serious problem, but its relationship to the willingness of individuals to assume a greater degree of responsibility for developing their own sources of research support is not commonly recognized among Tiros managers or research personnel. There is a lack of explicit recognition of a major kind of action that might be taken to alleviate the problem. This might be said to constitute an implicit means-end conflict problem.

Therefore, conflicts between managerial requirements and employee interests do not represent the only kinds of conflicts that can disrupt organizational effectiveness. The ability of organizations to achieve their goals effectively may also be disturbed by conflicts between what managers and employees commonly recognize as important on the one hand, and on the other hand, structural limitations imposed by the nature of the organizational and industrial system in which these organizations are imbedded; or the ability of organizations to achieve their goals effectively may be impaired by a lack of recognition of means or mechanisms that might be used to overcome perceived difficulties in organizational operation. Consideration of such means-end conflict problems represents, in part at least, a merging of certain perspectives from the rational-technical model of organizational analysis with the natural-system model which predominates in this analysis. We find that no one model or methodological perspective is completely adequate for describing and understanding organizational behavior.



#### IV INCENTIVES

To achieve the goals of an organization, management must do what is possible to alleviate conflicts within the organization. As was pointed out in the previous chapter, these conflicts may include discrepancies between managerial requirements and employee interests, between joint management-employee interests and structural limitations in the organization itself, and between perceived means to achieve organizational objectives.

Management has several mechanisms available to alleviate such conflicts. These include: (1) recruitment and displacement, whereby the organization obtains new members or employees who are likely to be most adaptable to organizational requirements and conditions and gets rid of maladjusted employees; (2) socialization, whereby individuals who may not be completely adapted to organizational requirements at first become more amenable over a period of time in the organizational context, and (3) incentives, whereby management manipulates available rewards and deprivations to induce maximum productivity and conformity to organizational objectives and requirements among employees. The use of certain incentives in this regard at Tiros is discussed in this chapter. Recruitment and socialization are discussed in Chapters V and VI.

Frequently, writings on the use of incentives by management have failed to come to grips with the important question, incentives for what? Does management have a clear idea about the kinds of behavior it wishes to induce in employees? Many writings have directed attention primarily toward the creating of conditions that maximize job satisfaction or general "morale" among employees. But happy employees may not necessarily be productive employees. Does management really want high morale, or does it want high productivity? Are the two behaviors at least correlated with each other, even if there is no necessary relation between them? Under what conditions is general job satisfaction associated with high productivity, and under what conditions is it not so associated? Such matters require further consideration before we examine the use of incentives at Tiros.

### The Satisfaction-Productivity Problem

Reports of past studies on relations between general job satisfaction and productivity present many apparent contradictions. For example, the well-known Hawthorne study described in detail how an increasing rate of productivity was associated with the development of a high degree of group morale in one work group at the Hawthorne plant (the Relay Assembly Test Room), whereas a restricted rate of productivity was associated with a similarly high degree of group morale in another work group (the Bank Wiring Room).<sup>\*</sup> March and Simon have summarized the research that has followed the pioneering Hawthorne study, indicating that:

. . . high satisfaction, per se, is not a particularly good predictor of high production nor does it facilitate production in a causal sense. Motivation to produce stems from a present or anticipated state of discontent and a perception of a direct connection between individual production and a new state of satisfaction.<sup>\*\*</sup>

In other words, individuals (or groups of individuals) are motivated to increase their productivity only where they see a relationship between producing more and a path to achieve a goal or goals that are important to them and that will give them a sense of satisfaction in their work.

Therefore, to induce higher productivity, it is necessary for management to demonstrate a close relationship between the interests of an individual employee and what the job management wants him to do. If he is already interested in the job, per se, then this is no problem at all; high job satisfaction will naturally be associated with high productivity. Where he would rather be doing something else, or where doing a particular task may conflict with the requirements of other tasks of more immediate interest, then management must use special rewards and inducements to channel behavior as desired. Before management can effectively use incentives for these purposes, however, it must recognize specifically (1) what kind of behavior it wishes to induce in employees--i.e., managerial requirements in relation to organizational goals; (2) what employees are already most motivated to do--i.e., their interests and the relation of these interests to managerial requirements; (3) what rewards

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\* F. J. Roethlisberger and W. J. Dickson, Management and the Worker (Cambridge, Mass.: Harvard Univ. Press, 1949).

\*\* James G. March and Herbert A. Simon, Organizations (New York: John Wiley & Sons, 1958), p. 51.

or inducements are likely to be most effective when attached to behaviors that management wishes to redirect; (4) how these rewards or inducements can be most effectively applied--how often, in what degree, in what relation to other incentives--to achieve the desired results.

We have already examined the goals at Tiros (institutional, technical, and service) and how these goals have been translated into managerial requirements (e.g., with regard to information acquisition, project assignment, technical assistance, and publication). We have also examined the kinds of activities in which Tiros research personnel tend to be most interested. We found the greatest discrepancy between the relatively low degree of employee interest in publication of research findings and the relatively high degree of management emphasis upon the desirability of publication. We also found that some Tiros managers apparently do not recognize the extent of this discrepancy. We concluded that a major management problem at Tiros is to induce researchers to produce more publications.

In his book on Scientists in Industry, William Kornhauser discussed in detail the conflict between the "organizational" orientation of most managers in industrial laboratories and the "professional" orientation of most scientists. He presented evidence from several studies showing that scientists are more likely to be motivated by "professional incentives," such as time off for professional meetings, professional rather than managerial ladders of career advancement, absence of compulsory work hours, refunding of tuition for additional academic training, and encouragement of publication. In contrast, he showed that persons (even with scientific backgrounds) who move into managerial positions are more likely to be influenced by such organizational incentives as further opportunity for advancement up a managerial ladder, salary scales, status symbols of value within the organization, etc. The implication of his discussion is that such differences in orientation generally obtain where scientists are employed in large non-academic organizations, and that these differences in orientation require the use of professional incentives that conflict with organizational requirements:

If the work establishment permits its professional employees to be identified solely with the profession and to treat the organization merely as a place of work, then it will not be able to motivate sufficiently its professional people to help achieve the goals of the organization. In consequence, professional contributions will be small and turnover high. If on the other hand, the organization seeks to stress organizational incentives at the expense of professional incentives,

then it will not be able to acquire a satisfactory professional performance from its specialists. In short, the work establishment faces the dilemma of seeking too much integration of its professionals into the organization and thereby losing their professional worth, versus granting them too much autonomy and thereby weakening their contribution to the organization.\*

This analysis may be true for scientists in industry, but it does not encompass the complexity of the situation in an organization like Tiros. At Tiros it is management that is more interested in a higher rate of publication among research personnel who are generally not as interested in publishing. Thus, although opportunity to publish is considered a professional reward in Kornhauser's analysis, it is an unfulfilled managerial requirement at Tiros. No evidence has been presented yet to indicate that Tiros research scientists who have more opportunity to publish are any more likely to be satisfied with their jobs in general than those who have less opportunity to publish. In other words, Tiros management probably desires to increase the rate of publication at Tiros--because of its contribution to the technical, service, and institutional goals of the organization--even if an increased rate of publication does not necessarily contribute markedly to the job satisfaction of the research scientists.

In fact, Table X shows that Tiros research personnel who are satisfied at Tiros are slightly less likely to emphasize the importance of publishing research findings than those who are dissatisfied. Those who are dissatisfied are slightly less likely to have published and are somewhat more likely to indicate that they "have not had much opportunity to publish" at Tiros. In contrast, data from the Business Research Department collected in Survey 2 indicates that dissatisfied researchers in that department are slightly more likely to have published findings based upon Tiros research.

So publication seems to be only slightly related to general job satisfaction at Tiros, if at all. This does not mean, however, that management at Tiros can afford to concentrate all its attention on increasing the rate of publication and neglect incentives to increase general job satisfaction. As March and Simon have pointed out, general job satisfaction has been shown to be related to decisions to participate in an

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\* Kornhauser, op. cit., p. 130.

Table X

IMPORTANCE ATTACHED TO PUBLICATION, EXPERIENCE OF  
OPPORTUNITY TO PUBLISH, AND PUBLICATION RATES AMONG  
SATISFIED AND DISSATISFIED RESEARCH PERSONNEL

	Index	
	Satisfied Research Personnel <sup>a</sup> (N = 204)	Dissatisfied Research Personnel <sup>b</sup> (N = 69)
Rating of importance of opportunity to write up and publish research findings in addition to Tiros reports	91	93
Rating of experience of opportunity to write up and publish research findings in addition to Tiros reports	52	37
Proportion of employees who have written one or more publications based upon re- search at Tiros	26%	22%

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Note: All data in this table are from Survey 3.

- a. Those personnel in Survey 3 who indicated that "taking everything into account," they were "very satisfied" or "satisfied" with their jobs in general. For the calculation of these indexes see footnote b in Table III (index can vary between 0 and 200).
- b. Those personnel in Survey 3 who indicated that "taking everything into account," they were "somewhat satisfied and somewhat dissatisfied," "dissatisfied," or "very dissatisfied" with their jobs in general. For the calculation of these indexes see footnote b in Table VI (index can vary between -100 and +200).

organization, although it may not be related to decisions to produce.\* This is certainly true at Tiros, where, as is shown in Table XI, there is at least partial evidence that job satisfaction in different parts of the organization is associated strongly with different rates of employee turnover in the past and different rates of anticipated turnover in the future.

Therefore, we must examine incentives available to management at Tiros with a view toward determining (1) which are most effectively used to improve general job satisfaction and (2) which are most effectively used to improve scientific productivity in terms of publication.

#### Types of Incentives at Tiros

Incentives can be categorized in various ways: monetary and non-monetary, positive or negative, intrinsic (to the work itself) or extrinsic, and professional or organizational in their orientation. In the following analysis we shall not use these categories directly, but instead shall describe incentives at Tiros that are primarily related to (1) the nature of the work performed, (2) resources for the work, (3) rewards for work accomplishments, and (4) career development opportunities. Here we assume that, in order to motivate individuals to meet the requirements of an organization, the organization must provide them with work opportunities that are related to these requirements, with ample resources to perform this work, with appropriate rewards geared to the successful performance of the work, and with career development opportunities linked to successful work performance. All types of incentives, to be effective, must operate in such a way as to link individual work behavior with organizational requirements. This categorization of incentives sidesteps, for the present at least, the issue of the relationship of these categories to "professional" versus "organizational" orientations of individuals, because of the difficulty of applying such a distinction in a clean-cut manner at Tiros, as indicated earlier.

The following analysis concentrates especially on the "positive" use of the four categories of incentives described, although the failure to provide any incentive that is highly valued by individual employees might also be considered to be a "negative" deprivation or disciplinary action. In fact, it may be characteristic of most organizations employing highly sophisticated personnel that they tend to avoid the overt use

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\* March and Simon, op. cit., p. 51.

Table XI

PROPORTIONS OF RESEARCH PERSONNEL DISSATISFIED WITH THEIR JOBS  
IN GENERAL, PAST TURNOVER RATES, AND ANTICIPATED  
FUTURE TURNOVER RATES IN THREE ORGANIZATIONAL SEGMENTS

	Segment <u>A</u>	Segment <u>B</u>	Segment <u>C</u>
Proportion of research personnel dissatisfied with their jobs in general	28%	44%	53%
Proportion of research personnel who resigned for jobs elsewhere in the 12 months preceding the survey	7	12	19
Proportion of personnel who in- dicate that they plan to leave Tiros within the next ten years to take jobs elsewhere	22	59	80

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Note: All data in this table are from Survey 2.

of disciplinary measures (e.g., firing, layoffs without pay, formal written reprimands) and tend to rely instead upon providing or withholding positive rewards as motivating devices. A more juridical concept of discipline with formalized lists of offenses, set penalties, and "due process" represented in formalized grievance channels tends to be avoided in the management of more professionalized employees, where professional standards supplemented by positive managerial incentives are relied upon to keep order in the enterprise.\*

Some incentives are more subject to managerial manipulation than others. Perhaps the most manipulable and therefore most readily recognized incentive is monetary reward for work accomplishment. However, as will be shown later in this chapter, this is not necessarily the most effective incentive for inducing professional employees to produce more or to be more satisfied with their jobs in general. Non-monetary rewards may be less manipulable and therefore less often recognized as available incentives, but nevertheless more effective. Such non-monetary rewards include incentives directly related to the nature of the work performed by research scientists, such as (1) opportunity for the individual to choose the kind of research he undertakes rather than to be assigned arbitrarily to a research task; (2) opportunity to direct the research undertaking as a "project leader" rather than to serve as a contributor to, or an assistant on, a research task directed by someone else; (3) opportunity to do a certain kind of research that is most in accord with the interests of the researcher and therefore perceived as "challenging" by him, whether this be "basic research" or "applied research"; (4) opportunity to associate with other researchers with whom an individual prefers to associate, whether they be from his own disciplinary background or drawn together into an interdisciplinary team from different backgrounds.

The importance of incentives that are related directly to the nature of the research work undertaken is illustrated in the following comments of Tiros research personnel written on survey questionnaires:

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\* An analysis of the more juridical concept of discipline and the associated concept of employee rights as these concepts have developed in American industry is presented in H. M. Vollmer, Employee Rights and the Employment Relationship (Berkeley and Los Angeles, University of California Press, 1960).



I feel it is more important to encourage more basic research in an organization the size of Tiros. Some researchers appear handicapped by lack of frequent contact with the latest thinking in their fields. While we undoubtedly set the "state of the art" in some fields, Tiros has an unusual opportunity to develop high competence in others. I strongly recommend that this continued development in quality of work be pushed and nurtured.

In contrast, another research scientist suggests that more emphasis should be placed upon applied research in another comment indicating a general concern with the nature of the work undertaken:

Applied research and development are considered as unworthy activities and described in derogatory terms in our division. We are not organized to do this type of work efficiently, or motivated to do it well. Yet a large number of individuals on the staff are best equipped by training and basic motivation for applied research and development.

Others are concerned with the size or length of research projects or with the alleged intrusion of developmental (selling) requirements upon research production activities:

I would like to see more research work of a long-term nature undertaken here. At present, too many projects are short range (less than a year). Most of the really significant problems in my field and in most others require five years or more of intensive work before any kind of really important results are forthcoming.

There are too many small projects, which implies that there is too much report writing, too much proposal writing, and too much selling activity by the average professional staff member.

We should improve opportunities for individual research and release technical people from some of the selling burden (proposal writing).

In turn, the importance of other incentives relating to resources for research--e.g., funds, information, and personnel, shown as inputs to research activities in Figure 2--is emphasized in many comments of Tiros employees. Following are some examples of comments expressing a concern with project funding:

Our main problem is the financing of research. Top management appears to make very little contribution to the acquisition of research contracts. The researcher writes the proposal and goes out and sells it. Most researchers are not especially gifted as travelling salesmen, and yet they spend half their time worrying about renewals and selling new contracts.

Management might attempt to get funds for more basic unsupported research. No doubt this would be difficult. It might also try to get government agencies generally to work on 2-year contracts rather than 1-year, unless performance is judged unsatisfactory by the sponsor. One-year contracts make one spend too much time lining up and worrying about future support.

The time lag between inception of an idea and actual arrival of a supporting contract is unsufferably long. It is very frustrating to wait 2 to 4 years for support of a research program which is obviously needed. (This applied primarily to government programs.)

Interest in personnel resources were expressed as follows:

We need a personnel recruitment and training program. Presently, recruiting is done after projects are in. Generally it is difficult, if not impossible, to add staff unless the person can be assigned to a project immediately.

We need to hire more sharp technicians and fewer green professionals.

A concern with information acquisition was frequently mentioned:

Time should be made available for informal study to keep abreast of developments in one's field of work; a small amount of time per week for reading and study which would not be charged to specific projects.

We should recognize the continually changing research needs of Tiros, and provide encouragement and a mechanism for re-training of staff members to do research in the new areas.

Opportunities for professional development beyond the doctoral level should be provided. The simplest way to do this is to follow the pattern of the better universities and provide sabbaticals for meritorious service to deserving individuals.

Other comments illustrate the importance of career development opportunities with regard to (1) transfers between activities within Tiros, (2) promotion into managerial positions, and (3) promotion to higher levels of responsibility in a professional, non-supervisory career ladder:

We should take steps to encourage transfers from one research group to another. This might include setting up means for making known the type of research other groups are doing and the kind of individuals they seek or need. This would encourage the open examination of other research opportunities within Tiros.

Management should adopt the philosophy that a good researcher can attain as high a status and salary as administrators and research promoters.

There should be some means of promotion of the senior man other than putting him in administration.

Still other comments stress the importance of monetary and non-monetary rewards for work accomplishment, such as (1) recognition by name and the enhancement of individual reputations in connection with their research, (2) salary recognition for research accomplishment, and (3) other forms of recognition:

Tiros should give more consideration to employees as persons and less as statistics or capital equipment.

In our division there are a few well-known Tiros names who are recognized on the outside in their research fields. But we are unable to meet requests for the services of these few well-known experts. A system of in-service training of younger scientists is needed to broaden our institutional and individual capabilities.

We should reduce salary disparities and base more modest salary differences on professional competence, training, and experience, rather than on administrative position and length of service.

There should be better means for rewarding the highly competent personnel, both research and administrative--such things as patent awards, educational or sabbatical privileges, more freedom for original or independent operation, increased financial remuneration, etc.

We should make it attractive to stay for those who are highly effective. As opposed to higher salaries, some would prefer more time off work to use as they see fit.

The question follows as to the relative potency of these different incentives at Tiros. Data on the relation of different incentives to over-all job satisfaction and to scientific productivity are presented in the following sections of this chapter.

#### Incentives and Over-all Job Satisfaction

Table XII shows the relationship of all incentives described previously to the over-all job satisfaction of Tiros research personnel. For the incentives especially related to the nature of the work performed, Table XII indicates that "having a large degree of freedom in selecting research assignments" is apparently the most powerful incentive in relation to over-all job satisfaction. Sixty-four percent of the researchers who are generally satisfied with their jobs indicated that they usually have a large degree of freedom in selecting their research assignments, while only 34% of the generally dissatisfied researchers have experienced such freedom.

"Having had sufficient opportunity to be a project leader"--that is, to be in charge of research projects--was also somewhat related to general job satisfaction, but less so than for freedom in project assignments. The aforementioned incentives were all more related to over-all job satisfaction than the experience of challenging research, opportunities to do either basic or applied research, or opportunities to work in interdisciplinary research situations.

Among the incentives related to resources, "having sufficient funds available to do the kind of research I want to do" was found to be most pertinent to general job satisfaction. In fact, it might be expected that the relationship of funding to general job satisfaction would be similar to the relationship of freedom of choice to general job satisfaction, since adequate funding of individual interests would normally be a prerequisite of independence in project assignments at Tiros. In contrast,

Table XII

EXPERIENCE OF GENERALLY SATISFIED AND GENERALLY DISSATISFIED RESEARCH  
PERSONNEL WITH DIFFERENT INCENTIVES

	(A) Generally Satisfied Research Scientists (N = 204)	(B) Generally Dissatisfied Research Scientists (N = 89)	Difference (A) - (B)
<u>Incentives related to nature of work</u>			
Have a large degree of freedom in selecting research assignments	64%	34%	30. %
Have had sufficient opportunity to be a project leader at Tirus	84	65	19.
Have had opportunity to do challenging research at Tirus	93	79	14.
Have had opportunity to do research that helps solve problems in industry or government	94	80	14.
Have had opportunity to do research that contributes to scientific knowledge	71	58	13.
Have had opportunity to do interdisciplinary research with researchers of different academic backgrounds	76	58	8.
Average difference for all incentives related to nature of work			16.3
<u>Incentives related to resources</u>			
Have sufficient funds available to conduct kind of research I want to do	63	35	28.
Have been able to keep up-to-date on new scientific developments	75	69	6.
Have adequate technical assistance	76	73	3.
Average difference for all incentives related to resources			12.3
<u>Incentives related to rewards for work</u>			
Have been recognized sufficiently by name in connection with my research at Tirus	79	65	14.
Have had an adequate salary	82	72	10.
Average difference for all incentives related to rewards for work			12.0
<u>Incentives related to career development</u>			
Have opportunity for promotion into management positions at Tirus	66	48	18.
Have opportunity for promotion within my research field	88	79	9.
Have sufficient opportunity to transfer from one research group or program to another within Tirus	78	70	8.
Average difference for all incentives related to career development			11.7

Note: All data in this table are from Survey 3.

there was very little relationship between general job satisfaction and having adequate scientific information or having adequate technical assistance.

In general, incentives related to the nature of the research undertaken appear to be more salient to over-all job satisfaction among Tiros researchers than incentives related to resources, rewards for work, or career development, as is indicated by comparing average differences for all four categories of incentives shown in Table XII. It can also be seen in Table XII that recognition by name in connection with research accomplishments apparently provides a more potent incentive for general job satisfaction than salary rewards. Also, opportunity for promotion into management positions at Tiros turned out to be a stronger incentive than opportunity for promotion within one's research field or opportunity to transfer from one group to another within Tiros.

Looking at the data in Table XII another way, it can be seen that those opportunities that are perceived as most unavailable to these research personnel generally tended to be most strongly associated with over-all job satisfaction and dissatisfaction--such as the provision of funds to support research interests, the allowance of a large degree of freedom in choice of research assignments, and the provision of opportunity for promotion into management positions. Management at Tiros has been able to make these opportunities available to a majority of its research personnel; however, there is a sizable minority of research personnel at Tiros whose job dissatisfaction is strongly associated with a sense of deprivation with regard to these items.

On the other hand, the large majority of research personnel at Tiros, whether generally satisfied or dissatisfied, feel that they have an adequate salary, have opportunity to do challenging applied research, and have opportunity for promotion within their research fields, if not into management positions at Tiros. Therefore, no further improvement in salaries, opportunities for applied research in general, or non-supervisory career development opportunities would be expected to have any marked effect upon job satisfaction at Tiros. Improvement in job satisfaction at Tiros is most likely to be achieved by finding ways to increase financial support and freedom of choice in relation to specific individual research interests. This conclusion is substantiated further by data reported in Table VI, which shows that the "most serious problems or frustrations" among managers and research personnel more frequently concerned "funds acquisition" and "relations between management and subordinates"--which in many cases referred to problems of freedom in research assignments.

### Incentives and Professional Productivity

Table XIII presents data showing the relationship of incentives to professional scientific productivity, which has previously been identified as a special managerial problem at Tiros. The data indicate that the research scientists who have produced at least one technical publication based upon research at Tiros are more likely to report that "they have had opportunity to do research that contributes to scientific knowledge" (which is, in a sense, validated by their indication that they have, in fact, produced one or more technical publications at Tiros), that "they have had sufficient opportunity to be a project leader at Tiros," and that they have had "a large degree of freedom to conduct the kind of research that they want to do." These findings substantiate further the findings of Leo Meltzer that scientific productivity is related to degree of freedom in choice of research assignments.\*

Meltzer also found that scientific productivity is related to adequacy of funding. While the present study found some relation for all three types of research resources, it was not as strong a relationship as for the aforementioned items. These incentives were all more related to scientific productivity than the experience of challenging research, opportunity to do applied research, or opportunity to work in interdisciplinary research situations.

Also, Table XIII indicates that recognition by name in connection with research accomplishments is strongly associated with scientific productivity, but satisfaction with salary is hardly associated at all. Recognition by name is probably not as much an incentive or inducement for producing publications as a consequence of publication, however.

There is very little relation between various career development incentives and scientific productivity, although there did seem to be a slight relationship between perceived opportunity to transfer at Tiros and scientific productivity. Again, however, this may be more a consequence than an inducement in relation to the production of publications.

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\* Leo Meltzer, "Scientific Productivity in Organizational Settings," Journal of Social Issues, Vol. 12 (1956), pp. 33-40; see also Leo Meltzer and James Salter, "Organizational Structure and the Performance and Job Satisfaction of Physiologists," American Sociological Review, Vol. 27 (1962), pp. 351-361.

Table XIII

**EXPERIENCE, WITH DIFFERENT INCENTIVES, OF RESEARCH PERSONNEL  
WHO HAVE NOT PUBLISHED AND THOSE WHO HAVE PRODUCED  
ONE OR MORE PUBLICATIONS BASED ON RESEARCH CONDUCTED  
AT TIROS**

	(A) Research Scientists Who Have Produced 1 or More Publications (N = 101)	(B) Research Scientists Who Have Not Published at Tiros (N = 188)	Difference (A) - (B)
<u>Incentives related to nature of work</u>			
Have had opportunity to do research that contributes to scientific knowledge	83%	59%	24. %
Have had sufficient opportunity to be a project leader at Tiros	94	72	22.
Have a large degree of freedom in selecting research assignments	69	50	19.
Have had opportunity to do challenging research at Tiros	95	69	6.
Have had opportunity to do research that helps solve problems in industry or government	94	89	5.
Have had opportunity to do interdisciplinary research with researchers of different academic backgrounds	78	73	5.
Average difference for all incentives related to nature of work			13.5
<u>Incentives related to resources</u>			
Have adequate technical assistance	88	77	11.
Have sufficient funds available to conduct the kind of research I want to do	63	53	10.
Have been able to keep up-to-date on new scientific developments	80	71	9.
Average difference for all incentives related to resources			10.0
<u>Incentives related to rewards for work</u>			
Have been recognized sufficiently by name in connection with my research at Tiros	88	69	21.
Have had an adequate salary	84	79	5.
Average difference for all incentives related to rewards for work			13.0
<u>Incentives related to career development</u>			
Have had sufficient opportunity to transfer from one research group or program to another within Tiros	83	73	10.
Have opportunity for promotion within my research field	89	84	5.
Have opportunity for promotion into management positions at Tiros	64	59	5.
Average difference for all incentives related to career development			6.7

Note: All data in this table are from Survey 3.



### Incentives: Summary

Examination of these data reveals that only one incentive appears to have potency with regard to both general job satisfaction and scientific productivity; other incentives appear to have limited effectiveness with regard to one factor, but not necessarily with regard to the other; and other incentives do not appear to have much effect on either factor under consideration here. These findings are summarized in Figure 3.

In Figure 3, freedom of choice in research assignments is shown to contribute both to a higher level of general job satisfaction and to a higher level of scientific productivity as indicated by number of publications. Those research personnel who reported more freedom in project assignments were considerably more likely to be satisfied with their jobs in general and to be producers of scientific and technical publications. Conversely, those who reported less freedom in project assignments were considerably less likely to be satisfied with their jobs in general or to publish.

It appears that Tiros management recognizes the potency of this incentive because, as has been pointed out earlier (see Table VI), Tiros management tends to place a strong degree of emphasis upon the desirability of this kind of freedom for research personnel. Nevertheless, as was also pointed out earlier, there does not seem to be a clear understanding--either in the minds of Tiros managers, or of researchers--as to how such freedom might be increased among individual researchers either by means of individual entrepreneurship or by means of increased management assistance in the procurement of research contracts of interest to individual research personnel.

Figure 3 also shows that adequacy of funds to support individual research interests does not, by itself, necessarily lead to increased scientific productivity (even though it is linked to general job satisfaction). It is when an adequate level of funding is associated with interests and opportunities in the direction of basic research that scientific productivity is more likely to be enhanced. Opportunity for promotions into management positions certainly tends to increase an organizational identification among individuals, and consequently their level of general job satisfaction, but (as many previous studies have pointed out) this does not necessarily increase scientific productivity.

In contrast, the "incentives" shown in the lower right hand corner of Figure 3 (which are really not incentives of any great potency in relation to general job satisfaction and scientific productivity at Tiros)

FIGURE 3

INCENTIVES IN RELATION TO OVER-ALL JOB SATISFACTION  
AND PROFESSIONAL PRODUCTIVITY AT TIROS

PROFESSIONAL PRODUCTIVITY

IS ASSOCIATED WITH

IS NOT ASSOCIATED WITH

GENERAL JOB SATISFACTION

IS ASSOCIATED WITH

- Freedom of Choice in Research Assignments

IS NOT ASSOCIATED WITH

- Opportunity To Do Basic Research
- Opportunity To Be Project Leader
- Recognition by Name in Connection with Research

- Adequacy of Research Funds To Support Individual Interests
- Opportunity for Promotion into Management

- Opportunity To Do Applied Research
- Opportunity To Do Inter-disciplinary Research
- Opportunity To Do Challenging Research
- Adequacy of Technical Assistance
- Opportunity To Keep Up-to-Date on Scientific Information
- Opportunity for Promotions in One's Research Field
- Opportunity To Transfer within the Organization
- Salary

are, in most cases, items of importance to individual researchers. These are also items whose importance management has recognized and which have been provided adequately for most, if not all, the research personnel at Tiros. Perhaps they have lost their potency for this reason--the fact that, by and large, they are adequately provided within the Tiros context. The items that are recognized by everybody as important, but that cannot be provided very adequately within the present Tiros structure, apparently remain as the most powerful incentives.

Further validation of freedom of choice in research assignments as a key incentive supporting both general job satisfaction and scientific productivity in research groups as well as among individual researchers is shown in Table XIV. From among 16 research groups within the divisions included in Survey 3 at Tiros, it is possible to identify six criterion groups, three of which were unusually high and three of which were unusually low on both general job satisfaction and on scientific productivity in terms of publications. By comparing the high and low criterion groups, it is possible to obtain a further indicator of the potency of certain incentive conditions for inducing high satisfaction and productivity. Table XIV shows that, as we would hypothesize from Figure 3 and the previous discussion, a greater degree of freedom of choice in research assignments appeared to contribute to the high level of job satisfaction and productivity in the one set of groups compared to the other. The proportion of research personnel who said that they usually had freedom of choice in their research assignments was consistently higher in the high satisfaction-productivity groups in comparison to the low groups.

In contrast, the extent of satisfaction with salaries did not vary consistently between the two criterion groups, for example. As stated earlier, satisfaction with salaries among research people who generally feel they are adequately paid does not appear to make much functional contribution either to high job satisfaction in general or to higher scientific productivity.

Table XIV

EXPERIENCE OF DIFFERENT INCENTIVES IN SELECTED RESEARCH GROUPS  
THAT ARE HIGH AND LOW IN GENERAL JOB SATISFACTION  
AND PROFESSIONAL PRODUCTIVITY

Incentives	High Satisfaction and Productivity <sup>a</sup>			Low Satisfaction and Productivity <sup>b</sup>		
	Group A	Group B	Group C	Group D	Group E	Group F
Have freedom of choice in research assignments	83%	75%	63%	43%	42%	14%
Have an adequate salary	100	83	88	86	92	65

Note: All data in this table are from Survey 3.

- a. The three groups with the highest proportions of personnel who were both satisfied with their jobs in general and who had produced one or more publications based on Tiros research. The proportions satisfied with their jobs in general varied between 75% and 100% in the three groups, and the proportions who had produced one or more publications were 66% or 67% in the three groups.
- b. The three groups with the lowest proportions of personnel who were both satisfied with their jobs in general and who had produced one or more publications based on Tiros research. The proportions satisfied with their jobs in general varied between 43% and 67% in the three groups, and the proportions who had produced one or more publications varied between 0% and 16% in the three groups.

## V RECRUITMENT AND DISPLACEMENT

As indicated in the previous chapter, management can attempt to reduce conflicts and problems in the adaptation of individuals to organizational requirements by manipulating available incentives or inducements. Another mechanism in conflict reduction within organizations involves controlling the kinds of individuals who become members or employees of the organization. This includes attempts to recruit individuals with backgrounds that increase the likelihood that they will conform to managerial requirements and to get rid of the kinds of individuals who are maladjusted. The objective of this mechanism of recruitment and displacement is to obtain a "mix" in the composition of the organization that is more amenable to the efficient accomplishment of organizational goals.

To be able to use the mechanism of recruitment and displacement most effectively, however, management must determine exactly what kinds of employees are most amenable to fulfilling organizational goals and management requirements related to these goals. Therefore, the questions arise: What kinds of research scientists does Tiros hire? Are these individuals, in fact, most likely to conform to managerial requirements at Tiros? If they are not, is management at Tiros aware of this? In other words, does Tiros management fully recognize what kind of research scientists the organization really needs?

These are questions to which the discussion in this chapter is addressed. In this discussion and analysis, we shall pay particular attention to (1) the major sources of recruitment for new Tiros employees; (2) the educational levels of new Tiros employees; and (3) the age levels of new Tiros employees. First, however, we shall generally discuss the problem of recruitment and displacement in the special context of Tiros.

### The Recruitment and Displacement Problem at Tiros

Management pronouncements at Tiros frequently reflect the general belief that competent and creative researchers are its most important asset. Following are typical management comments that reflect this emphasis:

We have a lot of things to look back on with pride: we have a major part of our physical plant in excellent shape; our financial picture is bright; the record of research accomplishment is good. But the greatest asset of Tiros is the staff--a group of dedicated men and women who have effectively made the organization work.

Many factors have been important in past successes and failures at Tiros. The key factor, however, has been the composition and quality of the professional staff. Future successes, or failure, will depend upon the capability of the research staff and the effective use of these capabilities to meet new requirements. The ability to keep and motivate superior staff and to attract others is one of the major tasks that lies ahead.

Personnel are recruited to the staff of Tiros by two principal means: (1) through contact with individual members of the present staff and (2) by unsolicited application. Tiros does not engage in much systematic recruiting at universities, professional meetings, etc., as do many industrial organizations that employ scientists and research engineers. Primary emphasis upon personal contact is indicated in the following comment in a speech by a Tiros division director to his employees:

The best people we have acquired throughout our history have been the colleagues that the research staff has identified and brought here. Sometimes recruits are your close associates; sometimes you observe them at professional society meetings or elsewhere. When you see that they have the kinds of talents that would fit in, invite them here for interviews. We cannot centralize this activity. It has to be done by all of us.

This and similar comments indicate that Tiros tends to hire new personnel in more of a "closed labor market," based upon personal acquaintance, rather than an "open labor market," based upon wide publication or vacancies and ranking of applicants by purely "objective" background or test criteria. In this regard, hiring practices at Tiros might be characterized as more like those in leading universities than like those in civil service establishments.\*

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\* The university pattern has been described in Theodore Caplow and Reece McGee, The Academic Marketplace (New York: Basic Books, 1958), pp. 109-137.

The emphasis upon personal contact probably provides a means of screening new applicants on their "human relations" potential in addition to their technical potential. Consideration of whether or not a research scientist would work well with other researchers is always important in organizations that take pride in their ability to put together various kinds of research teams to meet client requirements. The importance of such interpersonal considerations at Tiros is indicated in the following comments by research scientists:

We should consider a more careful screening of applicants; try to insist that personnel applying be interviewed by those who may presently be responsible for their efforts on project teams.

In the selection of professional researchers, more emphasis should be placed on qualities such as the ability to write reports, reasoning ability, sound educational background, and a desire to get along with colleagues.

It should be pointed out, however, that not all successful researchers at Tiros are considered to be friendly and personable by their colleagues. A few individuals are more or less isolates, who work on one-man research programs, who are able to maintain strong client support for their programs, and who are known among their colleagues as "hard to get along with." As one manager has stated:

One of the most difficult problems is the handling of the "star" performer whose drive for excellence often creates irritations among colleagues and difficulties for managers and administrative personnel. The requirement for teamwork on projects often limits the effective use of "genius." In some cases, it is inevitable that the "star" must work along with a staff of junior people and not be counted upon to work with other seniors or to handle several assignments concurrently.

An unsolved problem is to determine the most effective mix of "stars" and "team performers" in an organization like Tiros.

Along with the concern for recruiting appropriate types of personnel into Tiros is a concern for being able to get rid of ineffective researchers. In the previous chapter, it was pointed out that disciplinary discharge tends to be avoided, at least overtly, in professional organizations. What does happen in organizations like Tiros is that personnel layoffs, occasioned by dips in the demand for research services associated with economic recessions, general cutbacks in defense spending,

etc., provide the most useful general mechanism for getting rid of "marginal" employees. Data presented in Table I suggest that general layoffs occurred at Tiros in 1956 and 1959.

However, reliance upon such happenstance opportunities to get rid of weaker employees is not accepted as sufficient by many employees at Tiros, who feel that there should be more systematic means under the direct control of the organization itself to weed out researchers whose performance is unsatisfactory over a long period of time. Following are some expressions of opinion of this type by research personnel themselves:

Though I have been at Tiros only a fairly short time, I gain the impression that "no one is fired from Tiros." I feel that someone who is not carrying his load ought to be released.

We should be less reluctant to promote "turnover" when performance of staff deteriorates and frank appraisal and discussion fails to restore it. Otherwise, we keep the non-contributors and lose only the better people.

We should quietly ask the deadwood to leave.

We should be more hard-hearted with groups and personnel who are not producing.

In part, the reluctance to fire individuals at Tiros may result from the lack of concrete goals in the organization (in relation to which individual performance can be easily measured), as was pointed out in the chapter on managerial requirements. Performance with regard to the technical goals of Tiros can be easily measured in terms of numbers of publications--but this is only crudely indicative of the more basic research interests of Tiros, and not necessarily of its applied research interests. Also, there is no comprehensive indicator of performance with regard to the service goals of Tiros, except perhaps for very unsystematic comments of appreciation from clients, sometimes expressed formally in writing. In contrast with technical and service goals, one can evaluate the performance of an individual or a research group or program in terms of the institutional goals of Tiros in a very specific way--that is by checking financial data on amount of time "sold" on research projects in relation to "unsold" time. But ability to sell time on research projects does not always indicate the technical quality of the research or the nature of the service benefits resulting therefrom. Thus, some individuals or programs who are not rated high by their colleagues in the technical content of their research, or in the service



benefits deriving therefrom, can be retained because of their financial performance.

Perhaps the most trying recruitment-displacement problem from the standpoint of Tiros management is aligning the supply of available qualified personnel with research project demands, which may fluctuate considerably in response to economic conditions or changes in government defense spending. Table IV presents data indicating that "having available an adequate staff for technical assistance" on projects is one of the more emphasized managerial requirements at Tiros. A management spokesman has reflected this requirement by stating that "the most pressing current problem is an imbalance between staff and immediate workload." He went on to indicate that this imbalance might be remedied by more "backlogging" of research projects to await the availability of personnel currently working on other projects.

It is difficult to delay the initiation of most applied research projects, however--especially those sponsored by private industrial firms and some defense agencies, who tend to be "in a hurry" for research answers to their problems. When large projects of this type come into Tiros, there is a tendency to shave qualifications requirements in order to hire new personnel immediately to fulfill these project requirements. Management recognizes that the quality of new hires is enhanced by hiring with regard to long-run potential for utilizing the individuals rather than with regard to immediate and specific project requirements. On the other hand, the financial structure of Tiros itself, depending almost entirely upon research project revenue, cannot permit the hiring of too many individuals on their long-run potential without more immediate and visible means of financial support on project work.

Thus, in sum, hiring is a problem at Tiros because management is not certain about the kinds of individuals and their mix that is most appropriate to support the goals of the organization. Displacement is a problem because there is no systematic means to evaluate the performance of individual researchers in relation to all of the goals of the organization. Finally, a conflict exists between the need to hire researchers in terms of long-run contributions and the need to keep the institution solvent by having as much researcher time "sold" directly to research projects as possible.

#### Sources of New Employees

We have considered the general shape of the recruitment-displacement problem at Tiros. Now we can begin to examine more detailed questions, such as, where do the Tiros staff members come from?

Table XV shows that the larger proportion of its research personnel have come to Tiros directly from industrial or commercial organizations, followed by a smaller proportion of personnel from academic institutions. Still smaller proportions of its staff have come from military service, government employment, independent research or consulting firms, or self-employment. Only a small proportion have come to Tiros directly from school (those indicating no previous employment).

Table XV also shows that the pattern of recruitment is roughly similar in different parts of Tiros, except perhaps for the fact that research personnel in the more applied research activities covered in Survey 2 (the Business Research Department and Systems Research Division B) are slightly more likely to have come from private industry, independent research or consulting, or government service. Research personnel in the more basic research activities covered in Survey 3 (the Engineering Technology Divisions and Systems Research Division A) are slightly more likely to have come directly from school, academic employment, or military service.

What difference do these patterns of recruitment make with regard to the adaptation of employees to managerial requirements? Are new employees from industrial contexts any more amenable to various managerial requirements than new employees from academic contexts, or vice versa?

Table XVI throws some light on these questions. There we can see that new employees from academic institutions are more likely to be entrepreneurial with regard to their attitudes toward selling research ideas to prospective clients, to be interested in publishing research findings, to desire a large degree of freedom in research assignments, to prefer basic research activities, and to have little interest in promotion to management positions at Tiros. In contrast, new research personnel from private industrial or commercial contexts are less likely to be entrepreneurial with regard to selling research ideas to prospective clients, less likely to be interested in publishing research findings and in freedom in research assignments, more likely to be interested in conducting applied research activities and in following through to help implement these findings, and more likely to be interested in promotion into managerial positions at Tiros.

These findings would be expected in view of findings from many previous studies concerning differences in the context and orientation of research activities in industry compared with the university. It may be somewhat surprising, however, that researchers with academic backgrounds tend to be more entrepreneurial in their attitudes than do those

Table XV

PROPORTIONS OF RESEARCH PERSONNEL RECRUITED  
FROM VARIOUS SOURCES

Employment Immediately Prior to Joining Tiros Staff	Percent	
	All Research Personnel in Survey 2 (N = 163)	All Research Personnel in Survey 3 (N = 271)
Federal, state, or local govern- ment agency	6%	3%
Military service	7	12
Private industrial or commercial organization	51	44
Academic institution	17	18
Independent research or consult- ing firm	9	6
Self-employment	1	1
No full-time employment	7	15
Other	2	0

Table XVI

**EMPHASIS ON MANAGERIAL REQUIREMENTS AND THE IMPORTANCE OF THESE  
REQUIREMENTS TO RESEARCH PERSONNEL, BY SOURCE OF RECRUITMENT**

Item	Managerial Requirement Index <sup>a--</sup> All Managers in Survey 3 (N = 42)	Employee Importance Index <sup>a--</sup> Those from Academic In- stitutions <sup>b</sup> (N = 12)	Employee Importance Index <sup>a--</sup> Those from Private Industry <sup>b</sup> (N = 41)
Selling research ideas to prospective clients	92	92	69
Keeping up-to-date on new scientific developments	176	151	159
Having available adequate technical assistance	144	149	146
Publishing research findings in addition to Tiros reports	133	116	105
Helping clients implement Tiros research	104	101	112
Exercising a large degree of freedom in choice of research assignments	150	167	132
Doing research that contributes to scientific knowledge	157	142	131
Doing research that helps solve problems in industry or government	161	124	159
Seeking promotion within a research field	143	149	142
Seeking promotion into management positions at Tiros	100	74	85

a. The calculation of indexes is explained in footnote b in Table III (index can vary between 0 and 200).

b. These are research personnel in Survey 3 who have been employed at Tiros for less than two years time--a qualification added in an attempt to ascertain the effects of previous employment rather than the effects of more prolonged employment at Tiros.

with industrial backgrounds.\* However, this is to be expected if one considers carefully the highly competitive and risky context of research activities in many large university contexts. In such contexts, the individual must assume responsibility for seeking and obtaining grants or contracts to support his research activities, and the successful accomplishment of such activities is very directly relevant not only to promotions, but also to mere survival in many academic departments.\*\* In contrast, funds to support research activities are usually allocated as segments of annual budgets in large industrial enterprises. Even though a research department supervisor in industry may have to participate quite actively in periodic struggles to maintain or increase his research budget, the individual researcher may not be as likely to participate in this kind of entrepreneurial struggle himself. Therefore, some researchers who come from a more bureaucratic environment in industry into a more entrepreneurial environment like that of Tiros find it difficult to adjust to this aspect of the environment.

It has been indicated in Chapter III that the greatest discrepancy between managerial requirements and employee interests at Tiros is with regard to the publication of research findings; management tends to be much more interested than the researchers in increasing the output of publications. Also, although management at Tiros does not tend to place a great deal of emphasis upon individual responsibility for selling ideas to prospective clients, management does tend to emphasize this factor more strongly than most of the research personnel. Data in Table XVI suggest that interest in publication and individual entrepreneurship would be enhanced by hiring larger proportions of research personnel from university staffs. Management at Tiros may not fully recognize this fact, however, in that the ratio of research personnel from industry compared with those from academic institutions is larger among new hires than among the older Tiros personnel.

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\* Survey 1 similarly found that among two groups of physical scientists at Tiros, those with academic backgrounds were more likely to report that they have been able to obtain sufficient funds from clients to support the kind of research they want to do; see Vollmer, A Preliminary Investigation and Analysis of the Role of Scientists in Research Organizations, p. 101.

\*\* See Caplow and McGee, op. cit., esp. pp. 81-93.

On the other hand, Table XVI also shows that research personnel of industrial backgrounds do tend to be more interested in applied research and implementation activities, and therefore probably contribute more to the goals of the organization in this respect than those of academic backgrounds. Again, as long as the objectives of an organization like Tiros embrace such a diversity of objectives--from basic research to applied research, and from high technical quality to prompt service in problem-solving activities--there will be a need for a mix of research personnel from both academic and industrial sources. The ideal proportions of one type of personnel to the other within this mix cannot be easily determined, however, and certainly need to vary somewhat within the diverse divisions and sections of the Tiros organization.

#### Educational Level of New Employees

Along with past experience, the educational level of new applicants constitutes an important factor in recruitment and displacement at Tiros. Table XVII shows that the larger proportion of total research employees at Tiros presently hold master's degrees. There are about twice as many individuals with master's degrees as with doctor's degrees, mostly Ph.D.'s.

Table XVII

#### PROPORTIONS OF RESEARCH PERSONNEL WITH DIFFERENT EDUCATIONAL LEVELS

Highest Educational Level Completed	Percent	
	All Research Personnel in Survey 2 (N = 163)	All Research Personnel in Survey 3 (N = 271)
Doctor's degree	24%	20%
Master's degree	48	43
Some graduate school	20	21
Bachelor's degree	6	14
Less than bachelor's degree	3	2

Also, Table XVII shows that the proportions of individuals in various degree categories have a similar pattern in different general areas of Tiros, although there may be a slightly greater tendency for the Engineering Technology Divisions and Systems Research Division A to employ professional personnel without advanced academic degrees. The ratio of those with doctor's degrees to those with master's degrees is about the same among new hires as among the total research population for the Tiros divisions included in Survey 3. Thus, there does not appear to be any current tendency for shifting either toward, or away from, hiring a higher proportion of researchers with Ph.D.'s.

What differences do these degree backgrounds make with regard to the adaptation of research scientists to different managerial requirements?

Data relating to this question are presented in Table XVIII. Several findings emerge from this table. One pattern of findings concerns the direct relationship between educational level and certain managerial requirements. In this regard, there is a decreasing degree of adaptation--from Ph.D.'s through those with master's degrees down to those with less than master's degrees--with regard to publishing research findings in addition to Tiros reports. Also, Ph.D.'s among newer employees are more likely than non-Ph.D.'s to emphasize the importance of keeping up-to-date on new scientific developments in their fields, exercising a large degree of freedom in project assignments, and doing research that contributes to scientific knowledge.

At the other extreme, those without advanced degrees are more likely to be interested in implementation of research findings and in enhancement of their own promotional opportunities, both within their research fields and/or into management positions. Those with master's degrees do not necessarily fall in between these extremes on all items; on certain items they tend to form a pattern all their own. For example, those with master's degrees are more likely to be oriented toward the values of applied research, rather than basic research, and are less likely than individuals in the other two categories to be concerned with keeping up-to-date on new scientific developments and exercising a large degree of freedom in project assignments.

Therefore, in sum, it appears that Ph.D.'s at least in engineering technology areas, are more science-oriented in their desire to keep in contact with their scientific disciplines, to make periodic contributions to these disciplines by producing technical publications, and by demanding the kind of freedom that is usually associated with these

Table XVIII

**EMPHASIS ON MANAGERIAL REQUIREMENTS AND THE IMPORTANCE OF THESE  
REQUIREMENTS TO RESEARCH PERSONNEL, BY EDUCATIONAL LEVEL**

Item	Managerial Requirement Index <sup>a--</sup> All Managers in Survey 3 (N = 42)	Employee Importance Index <sup>a--</sup> Those with Ph.D. Degrees <sup>b</sup> (N = 17)	Employee Importance Index <sup>a--</sup> Those with Master's D. <sup>b</sup> (N = 34)	Employee Importance Index <sup>a--</sup> Less than Master's D. <sup>b</sup> (N = 25)
Selling research ideas to prospective clients	92	72	84	84
Keeping up-to-date on new scientific developments	176	171	147	156
Having available adequate technical assistance	144	141	141	140
Publishing research findings in addition to Tiros reports	133	129	95	88
Helping clients implement Tiros research	104	71	111	118
Exercising a large degree of freedom in choice of research assignments	150	166	123	136
Doing research that contributes to scientific knowledge	157	159	111	136
Doing research that helps solve problems in industry or government	161	118	174	164
Seeking promotion within a research field	143	123	129	160
Seeking promotion into management positions at Tiros	100	66	83	116

a. The calculation of indexes is explained in footnote b in Table III (index can vary between 0 and 200).

b. These are research personnel in Survey 3 who have been employed at Tiros for less than two years' time--a qualification added in an attempt to ascertain the initial effects of degree background rather than the effects of more prolonged employment at Tiros.



kinds of efforts. In contrast, those with master's degrees are more application-oriented in their research interests and are willing to forego what might be considered to be more science-oriented prerogatives in order to focus their attention more effectively upon specific problem-solving applied research efforts. Finally, researchers without advanced degrees appear to realize that career security for them depends directly upon their ability to advance into higher level positions where they can administer, coordinate, or service the activities of researchers with advanced degrees and the special capabilities implied by these degrees. They, then, tend to be career-development-oriented in their perspectives toward their work.

These findings suggest that caution may be advisable when attempting to attribute a too-literal interpretation to NSF-BLS forecasts that the demand for Ph.D. scientists and engineers in American industry is increasing.\* In reality, it may be that many industrial corporations are predicting an increasing demand for Ph.D. scientists and engineers in which application-oriented technical personnel with master's degrees might actually be most useful in terms of their education, experience, and interests.\*\* At least at Tiros, management appears to recognize the need for a useful balance between Ph.D.'s and master's degree holders in research activities that embrace both applied and basic research objectives.

There is, however, one finding in Tables XVI and XVIII that appears to be incongruent at first glance. This is the finding that a higher proportion of individuals who came to Tiros from academic backgrounds appeared to be interested in selling research ideas to prospective clients, whereas a lower proportion of Ph.D.'s appeared to be entrepreneurial in their attitudes toward research funds acquisition. This

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\* For an example of a current forecast emphasizing the "continuing shortage" of research scientists and engineers at the Ph.D. level, see U.S. Department of Labor, Bureau of Labor Statistics, Scientists, Engineers, and Technicians in the 1960's--Requirements and Supply (Washington, D.C.: a report to be issued by the National Science Foundation, 1963).

\*\* For example, only about 13% of the scientists and engineers in the aerospace industry in 1961 were employed in research activities; see Stanford Research Institute, The Industry-Government Aerospace Relationship, Vol. II, Supporting Research (Menlo Park, Calif.: a report to the Aerospace Industries Association, 1963), Table H-4.

may simply reflect the fact that Ph.D.'s are generally more successful in selling clients on supporting their research ideas than non-Ph.D.'s; in fact, other data indicate that this is the case at Tiros. It may appear to clients who have no specific knowledge of individual research capabilities that Ph.D.'s have more to offer. Thus, Ph.D.'s may be able to afford a more casual attitude toward entrepreneurship, while concentrating their attention upon publication efforts (which, of course, in themselves constitute aids in selling research).

#### Age Level of New Employees

The age level of new applicants constitutes the third item to be examined here in relation to recruitment and displacement. Table XIX shows that most research personnel at Tiros are in the 30-39 age range. Somewhat higher proportions are in their 20's in the Engineering Technology and Systems Research Division A included in Survey 3, and higher proportions are 40 years or over in the Business Research and Systems Research Division B included in Survey 2. It appears, therefore, that the experience associated with age is more functional to the more heavily applied research activities included in Survey 2 as compared with those included in Survey 3. Analysis of other data indicates again that there is no trend toward, or away from, hiring younger or older researchers at Tiros.

Table XIX

#### PROPORTIONS OF RESEARCH PERSONNEL IN DIFFERENT AGE CATEGORIES

Age	Percent	
	All Research Personnel in Survey 2 (N = 163)	All Research Personnel in Survey 3 (N = 271)
29 years or less	10%	22%
30 to 39 years	53	50
40 to 49 years	31	25
50 years or over	6	3

Table XX shows that there are quite a few managerial requirements at Tiros that are more likely to be given stronger emphasis among new employees of younger ages than among older hires. The items given stronger emphasis among the younger personnel are: selling research ideas to prospective clients, keeping up-to-date on new scientific developments, having adequate technical assistance, publishing research findings, implementing research findings, and doing research that contributes to scientific knowledge. It may be that these findings reflect the possibility that younger individuals are less focused in their research interests--their interests tend to range over almost all the input and output processes included in a research enterprise, as is shown in Figure 2. Older individuals, on the other hand, tend to be much more focused in their interests in sticking close to applied research production activities. They apparently know pretty well what they want to do. They may have had more experience in some field of specialized research interest, but they also appear to be less flexible and adaptable to the wide range of activities necessary to maintain an ongoing research activity.

The findings in Table XX also suggest that it is in their 30's that research personnel are most likely to be concerned with promotion within their research fields. In the 40's, the desire for, and acceptability of, managerial responsibilities appears to increase.

These findings generally support the feasibility of employment of younger, more vigorous and adaptable personnel in research activities, which appears to be in accord with recruitment policies at Tiros. On the other hand, this also opens additional questions concerning the forecasted shortage of scientific and engineering personnel for a national perspective. Could it be that there is a large pool of older research talent in the nation that is not as fully utilized and not as employable as younger researchers because the older personnel are perceived (apparently correctly) as less flexible and adaptable to changing organizational requirements? If so, could anything be done about it? Could anything be done to retrain such individuals in new research areas and to restimulate their motivation to broaden their capabilities in line with changing organizational requirements? Whatever could be done along these lines might help to relieve apparent shortages of creative talent, not only at Tiros, but in the nation as well.

#### Recruitment and Displacement: Summary

Table XXI indicates that there is little, if any, association between the source, education, or age of new Tiros employees, on one hand,

Table XX

**EMPHASIS ON MANAGERIAL REQUIREMENTS AND THE IMPORTANCE OF THESE  
REQUIREMENTS TO RESEARCH PERSONNEL, BY AGE CATEGORY**

Item	Managerial Requirement Index <sup>a--</sup> All Managers in Survey 3 (N = 42)	Employee Importance Index <sup>a--</sup> Those Age 29 or Less <sup>b</sup> (N = 23)	Employee Importance Index <sup>a--</sup> Those Age 30 to 39 <sup>b</sup> (N = 33)	Employee Importance Index <sup>a--</sup> Those Age 40 or Over <sup>b</sup> (N = 20)
Selling research ideas to prospective clients	92	103	78	60
Keeping up-to-date on new scientific developments	176	170	155	140
Having available adequate technical assistance	144	144	142	135
Publishing research findings in addition to Tiros reports	133	109	108	75
Helping clients implement Tiros research	104	109	108	95
Exercising a large degree of freedom in choice of research assignments	150	147	149	105
Doing research that contributes to scientific knowledge	157	149	136	100
Doing research that helps solve problems in industry or government	161	125	143	180
Seeking promotion within a research field	143	144	146	120
Seeking promotion into management positions at Tiros	100	83	90	95

a. The calculation of indexes is explained in footnote b in Table III (index can vary between 0 and 200).

b. These are research personnel in Survey 3 who have been employed at Tiros for less than two years' time--a qualification added in an attempt to ascertain the initial effects of age level rather than the effects of more prolonged employment at Tiros.

Table XXI

INDICATORS OF WORK PERFORMANCE AND GENERAL JOB SATISFACTION  
BY SOURCE, EDUCATION, AND AGE OF NEW RESEARCH PERSONNEL

	Percent Satisfied with Job <u>in General</u>	Percent Mostly <sup>a</sup> Project <u>Leaders</u>	Percent Who Have Written 1 or More <u>Publications</u>
Source of recruitment			
Private industry (N = 41)	88%	10%	10%
Academic institution (N = 12)	84	17	17
Highest academic degree			
Doctor's degree (N = 17)	82	12	24
Master's degree (N = 34)	85	12	15
No advanced degree (N = 25)	80	12	0
Age category			
29 years or less (N = 23)	78	0	9
30 to 39 years (N = 33)	85	21	15
40 years or over (N = 20)	85	10	10

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Note: These are all research employees of less than two year's employment who participated in Survey 3.

a. Served as project leader on 50% or more of their project assignments.

and their general job satisfaction at Tiros. There is, however, some association between age, especially, and source of recruitment, on the one hand, and, on the other hand, whether or not employees have served mostly as project leaders or directors on the research efforts to which they have been assigned in the short period of time they have been at Tiros. Researchers who are 30 to 39 years old and from academic institutions are more likely to have served mostly as project leaders. This is compatible with the findings reported earlier that younger employees and those from academic institutions tend to be more concerned with individual entrepreneurship, which, in turn, is likely to lead to increased opportunities for project leadership.

Table XXI also shows associations between publication efforts and all three background factors. Those with higher academic degrees, especially doctor's degrees, are more likely to publish. This probably reflects the dual fact that they may have more built-in motivation to publish, as a result of a strong science orientation acquired during prolonged graduate training in academic contexts, and also that they may have more ability to write publications based upon the experience and theory they acquired in graduate training. In addition, those who came directly from academic backgrounds are more likely to publish, for reasons suggested above. Those in the age range 30-39 are more likely to publish, perhaps because they are also more likely to have held project leader positions, which provides a basis for publications. Also, they are more likely to be concerned with their own self-advancement in these years; self-advancement cannot be underrated as a motive for publication among scientists.

Management at Tiros does appear to recognize some relationship between the kind of scientific productivity management wishes to enhance and the kind of individual researchers acquired or displaced. This is indicated by the fact that individuals in the younger age brackets and with at least a master's degree academic background are, in fact, favored in Tiros hiring practices. It is apparently not as fully recognized at Tiros, however, that those from academic institutions, compared with those from industrial establishments, are more likely to have a strong entrepreneurial orientation associated with a desire to contribute to scientific knowledge.

## VI SOCIALIZATION

Socialization constitutes a third mechanism that tends to bring individual perspectives into alignment with organizational requirements and objectives. "Socialization" was originally used by sociologists to refer to the way in which the values of a larger society come to be internalized as the part of the personality structure of normal members of the society. In this regard, socialization usually has its most dramatic effects as infants become "human beings" and learn the standards of behavior appropriate to a particular society, and to their status within this society, during the period of early childhood. In more recent years, sociologists have used the concept of "socialization" to refer to a similar process whereby individuals become adapted to organizational requirements and increasingly experience these requirements and organizational values as a compatible aspect of their own individual interests after a period of time spent in a particular organizational context.\* Robert W. Avery has used a similar concept, "enculturation," to describe how research scientists gradually adapt to industrial contexts.\*\*

Thus, organizations not only attempt to change the composition of their membership and to motivate individual behavior in accord with organizational objectives, but also act, over time, to change the basic interests and orientations of their members or employees in certain directions important to the organization.

Much of the process of socialization may be unconscious, both on the part of management and on the part of an employee undergoing socialization. The employee may be largely unaware of the fact that his basic attitudes toward his organization, his work, and himself in relation to his work are changing. Nevertheless, there is considerable evidence that such

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\* See, for example, Leonard Broom and Philip Selznick, Sociology: a Text with Adapted Readings, 2nd edit. (Evanston, Ill.: Row, Peterson, 1958), pp. 216-217.

\*\* Robert W. Avery, "Enculturation in Industrial Research," IRE Transactions of the Professional Group on Engineering Management, Vol. EM-7 (March 1960), pp. 20-24.

changes do tend to take place over a long period of time in a particular organizational context. What looked attractive to the individual at one time may not appear as attractive later. What seems important to the individual after a long period of time in a particular organizational context are likely to be the same things that seem important to the other individuals with whom he has associated over this period. In other words, through the process of socialization an individual tends to reduce any "cognitive dissonance"\* that might exist between what he considers to be his own interests and the situational requirements to which he has obviously conformed.

While the mechanism of socialization may be examined abstractly apart from the processes of recruitment-displacement and manipulation of incentives, it is certainly associated with these other processes empirically. Thus, the addition of new personnel who are mostly interested in doing basic research may stimulate a shift in interest toward basic research among the older individuals within a research organization. Or prolonged acquiescence to the requirements of applied research activities under the inducement of high salaries may result in an eventual shift in interest toward applied research among scientists who were originally more interested in basic research. These adaptation mechanisms are interdependent.

Nevertheless, in this chapter we shall attempt a separate examination of how the process of socialization operates at Tiros and of the consequences of this process for employee responses to managerial requirements.

#### Socialization at Tiros

As in other contexts, the process of socialization at Tiros results in changes in individual behavior and attitudes over time. The pattern of change, however, is not linear over time. Instead, changes tend to occur according to a characteristic pattern of career development for the individual within an organizational context. This pattern of career

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\* Cognitive dissonance theory appears to go far in explaining the psychological components of the process of socialization; see Leon Festinger, A Theory of Cognitive Dissonance (Evanston, Ill.: Row, Peterson, 1957) and Jack A. Brehm and Arthur R. Cohen, Explorations in Cognitive Dissonance (New York: Wiley, 1962).



development may be described in terms of three main stages: (1) an initial period, characterized by an especially high degree of organizational identification and job satisfaction on the part of new employees; (2) an adjustment period, characterized by an especially low degree of organizational identification and job satisfaction among employees who have not yet decided to pursue a further career in their present organizational context or to accept opportunities still available elsewhere; and (3) a stable period, characterized by at least a tentative decision to continue as an employee of their present organization and by a growing commitment to this organization while the possibility for transfer to other organizations decreases.\*

This cyclical pattern of socialization has been noted as a general configuration in many studies of employee attitudes in different organizational contexts. Herzberg and his co-authors have summarized these studies as follows:

There are seven wide-range studies in which an early period of high morale drops to a low period. This is followed by a rising period of job satisfaction. For example, Arnold in a survey of job attitudes among journeymen printers found that men on the job between eight and thirteen years were the most dissatisfied, the newcomers relatively satisfied, and the men at work in this shop for more than thirteen years the most satisfied. Hull and Kolstad found that factory workers with under one year of service had higher morale than those with one to five years, and that those with five to ten years of service had the highest morale of all. McCluskey and Strayer report

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\* These career development stages, as characterized here, are somewhat similar to those proposed by Form and Miller. However, Form and Miller applied their analysis to stages of career development for an individual moving through a sequence of work activities in a total life development pattern, from youth to older age, without reference to particular organizational contexts. In contrast, the career development stages characterized here refer more specifically to the socialization of an individual within one particular organizational context. See William H. Form and Delbert C. Miller, "Occupational Career Pattern as a Sociological Instrument," American Journal of Sociology, Vol. 54 (1949), pp. 317-329; also Delbert C. Miller and William H. Form, Industrial Sociology (New York: Harper, 1951), Part Four.

that teachers with four to twelve years of service were less happy than those with either more or less experience.\*

At Tiros, it appears that satisfaction and organizational identification is very high during the first year, is at its lowest ebb in a period of adjustment from the second through the fourth year, and then gradually increases again from the fifth year of employment onward. The transition from an adjustment period to a more stable period of employment is ceremonially marked at Tiros by publishing the names of employees who have reached their five year anniversaries in the employees' magazine; by inviting them to an afternoon tea with the General Manager; and by a gift of a tie clip, pin, or bracelet with the organization emblem.

Data in Table XXII indicate that during the initial period of employment, few research personnel serve as project leaders and relatively few individuals have yet produced any publications based upon Tiros research--which is as it would be expected in the first year of employment.\*\* During this initial period, new research personnel are quite likely to be highly identified with Tiros, as indicated by the fact that about three-fourths of them hope to remain at Tiros for at least the next ten years. Also the vast majority of these individuals are likely to be very satisfied with their salaries, their immediate supervision, higher level management, and their jobs in general. Having made a significant career decision to join the Tiros staff, new employees tend to adjust their perceptions of working conditions in the organization in favorable directions which justify, or are congruent with, this decision--as cognitive dissonance theory would predict.\*\*\*

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\* These studies have been summarized in Frederick Herzberg, et.al., Job Attitudes: Review of Research and Opinion (Pittsburgh, Penn.: Psychological Service of Pittsburgh, 1957), pp. 11-13.

\*\* It would be most desirable to have data on changes in attitudes among the same individuals over time in an organization. Lacking such time series data, however, we must make what interpretations that we can from data for different individuals of different lengths of employment at the same point in time.

\*\*\* Cognitive dissonance theory includes the three following major propositions: "Dissonance almost always exists after a decision has been made between two or more alternatives. The cognitive elements corresponding to positive characteristics of the rejected alternatives; and those corresponding to negative characteristics

Table XXII

**CHARACTERISTICS AND ATTITUDES OF RESEARCH PERSONNEL  
BY LENGTH OF EMPLOYMENT AT TIROS**

	Initial Period	Adjustment Period		Stable Period	
	Less than 1 Year Em- ployment (N = 47)	From 1 to 3 Years Employment (N = 72)	From 3 to 5 Years Employment (N = 62)	From 5 to 10 Years Employment (N = 65)	Over 10 Years Employment (N = 26)
Served mostly as project leaders	9%	18%	19%	20%	42%
Number of publications per author per year	0.17	0.21	0.22	0.24	0.17
Consider present work as part of a career	70%	75%	78%	90%	87%
Consider "getting ahead in a job" as more impor- tant than "having a se- cure and dependable job"	68%	72%	73%	68%	58%
Believe that it would be very easy to get a simi- lar job elsewhere	53%	65%	65%	58%	54%
Hope to remain at Tiros for at least the next ten years	72%	64%	68%	71%	93%
Hope to move into a man- agement position at Tiros	30%	32%	42%	28%	27%
Satisfied with salary compared to salaries out- side Tiros	71%	53%	60%	63%	69%
Satisfied with salary compared to other sala- ries at Tiros	64%	60%	59%	73%	73%
Satisfied with immediate supervisor	87%	74%	69%	78%	62%
Satisfied with "higher level management" at Tiros	78%	60%	55%	48%	38%
Satisfied with job in general, taking every- thing into account	90%	70%	71%	74%	74%

Note: All data in this table are from Survey 3.

In contrast, Table XXII indicates that during the adjustment period that commences fairly quickly after initial employment and extends from about the second to the end of the fourth year of employment at Tiros, more individuals serve as project leaders, and the rate of publication per individual increases. During this same period, however, individuals have to make another kind of significant career decision: whether or not to remain at Tiros in the face of opportunities still open for jobs elsewhere. In fact, individuals are more likely to perceive opportunities to transfer to other organizations during this period, before they have become psychologically committed to a career at Tiros. They are less likely to be sure that they want to remain at Tiros in the face of these other opportunities elsewhere. The dilemma accompanying the need for significant decisions on whether to stay or leave during this period is associated in the minds of individuals with a high achievement orientation--"getting ahead in a job" is still perceived by most people as more important than "having a secure and dependable job." Concurrent with this achievement orientation is a greater likelihood that individuals are thinking seriously about opportunities for promotions into managerial positions.

Furthermore, as individuals become aware of the "backstage" limitations, weaknesses, and disadvantages of an organization that they once viewed only from "out front" when they first joined the organization, they are likely to become disenchanted with a previously over-idealized view of it.\* Hence, we find that the proportion of employees who are satisfied with their salaries, with higher level management, and with their jobs in general is lowest in this period at Tiros.\*\*

During the period of adjustment, some individuals decide to leave the organization and go elsewhere. Others overcome these perceived

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of the chosen alternatives are dissonant with the knowledge of the action that has taken place. . . . The presence of dissonance gives rise to pressures to reduce that dissonance. . . . Dissonance may be reduced . . . by changing one or more of the elements involved in dissonant relations" (e.g. attitudes toward working conditions); see Festinger, op. cit., pp. 261-264.

\* For a discussion of the concepts of "backstage" and "out front," see Erving Goffman, The Presentation of Self in Everyday Life (Garden City, N.Y.: Doubleday, Anchor, 1959), pp. 106-140.

\*\* If, as cognitive dissonance theory maintains, dissonance tends to be reduced after an individual has made a decision, it also appears to be true that dissonance tends to increase just before an individual has to make a decision.

temptations and stay. Since opportunities to leave were probably experienced by most individuals in their adjustment period, another conscious decision (or series of decisions) must be made before the individual concludes that he will remain at Tiros. The more stable period that follows this period of doubts and temptations is a post-decision period and, therefore, becomes a time of dissonance reduction--again, as would be predicted by dissonance theory.

Those who enter their stable period of employment at Tiros are even more likely to become project leaders, and the rate of publication increases for a time, although there is some evidence that the rate of publication tends to drop off somewhat in the later years of employment. In any case, almost all of these individuals have become committed to their work as part of a career. At the same time, however, as their perceived opportunities for jobs elsewhere begin to decline and, as their commitment to remain at Tiros increases, their emphasis upon job security in contrast to job achievement increases. Those who have remained in non-supervisory research positions this long are now no longer as likely to entertain ambitions to become research supervisors, at Tiros or elsewhere. Finally, satisfaction with salaries and general job satisfaction again tends to increase during this period.

There is one trend in the data in Table XXII which, at first glance, appears to be contrary to the other trends, however. This is the fact that the proportion of individuals who are satisfied with "higher-level management" tends to decrease markedly with length of employment at Tiros. (In contrast, the proportion of employees satisfied with their immediate supervisors varies somewhat with length of employment, but in no consistently increasing or decreasing pattern). Until data are available from other organizations, it is difficult to interpret the meaning of a declining extent of satisfaction with higher management. One might expect a more favorable attitude toward higher management as organizational identification and general job satisfaction increases in older employees. On the other hand, it must be recognized that criticism of higher management is almost a part of the "organizational culture" or way of life at Tiros. Many comments of this nature were written on survey questionnaires. These comments indicate a tendency to blame faceless "top management" people unknown personally to the researchers (rather than immediate supervisors who are known personally to researchers) for almost all their troubles in the organization.

On one hand, comments that higher-level management lacks an understanding of the problems at the working level in individual research laboratories are understandable in view of the tendency for top management at Tiros to accommodate quite different research interests by placing

them in separate organizational segments, as noted previously in Chapter II. Management at Tiros has decentralized a considerable degree of responsibility for pursuing different research interests and cannot be expected to be equally responsive to, and supportive of, each kind of interest at the same time. It can only coordinate the activities of Tiros in terms of its institutional goals; it must leave primary responsibility for the pursuit of different technical and service goals to the individual laboratories and divisions.

On the other hand, this separation between the interests of central management and individual research groups throughout Tiros on the working level allows opportunity for a scapegoat mechanism to operate. Blame for difficulties is attributed to a distant and unsympathetic "top management." This scapegoat mechanism, in turn, may even make it easier for individual researchers to devote their full attention to the research job at hand, much as griping about "the system" serves as an escape valve to allow soldiers to develop an esprit de corps and to perform their jobs effectively in military organizations.

If this interpretation is correct, then, learning to gripe about higher management is, paradoxically, part of the socialization process in which a Tiros researcher also develops a higher degree of commitment to the organization.

In summary to this point, it would appear that a career at Tiros eventually includes two significant career decisions on the part of an individual employee: (1) the decision to join the organization, and (2) after a few years, a decision to remain in the organization. (In practice, the latter is probably not a single decision at a given point in time, but rather a series of more-or-less significant decisions extended throughout the "adjustment period" of employment.) Furthermore, it appears that each decision is preceded by a considerable degree of cognitive dissonance, and each is followed by dissonance reduction, in accord with Festinger's theory. Only the latter type of decision, however, is followed by individual commitment to the organization. Further examination of the adaptation of individuals to a wide variety of other kinds of organized group contexts besides what we normally consider as an "employment relationship" (military service, joining a political movement or a religious order, marriage, etc.) might be expected to follow a similar two-decision cycle of adjustment.

We turn now to a consideration of the affects of socialization at Tiros upon employee responses to managerial requirements.

### Socialization and Managerial Requirements

Table XXIII indicates the effects of socialization upon employee responses to managerial requirements at Tiros by showing the pattern of employee responses after various periods of employment time. Analysis of these data show two different patterns for different items over time. Pattern One is a gradually decreasing amount of emphasis through each period of employment, from the initial period on into the stable period. This pattern of decreasing emphasis applies to "selling research ideas to prospective clients" and "publishing research findings"--the entrepreneurial and the professionally productive aspects of an individual scientist's activities.

Thus, it appears that a research scientist tends to become less interested in professional or scientific productivity and less interested in research entrepreneurship over time at Tiros. It will be recalled from Chapter III that these are two of the managerial requirements which deviate most from employee interests at Tiros. In other words, the process of socialization, though it results in an increasing degree of individual identification with, and commitment to, the organization at Tiros, does not result in a decreasing discrepancy between managerial requirements and employee interests, as might be expected. On the contrary, it appears to result in an increasing alienation between what managers and what employees consider to be important.

Somewhat paradoxically, it appears that "success" among research personnel at Tiros actually leads to ways and means for the research personnel to insulate themselves from managerial requirements. Many of them do this by becoming project leaders, as is indicated in Table XXII. Project leadership, in turn, makes individual researchers less dependent upon management for assistance in "selling their time" on research contracts. This independence from management also allows for the development of interests that diverge from managerial requirements and does not permit management as close a control over individual behavior and attitudes.

At the same time that researchers are becoming more independent from management at Tiros--by becoming leaders of their own projects--they are also becoming more independent of professional connections. Becoming more assured of, and committed to, a career at Tiros, they are not as dependent upon professional affiliations and contacts to get positions in other organizations. Furthermore, as pointed out previously in Chapter V, publication in scientific and technical journals is only one of many criteria for management evaluation of accomplishment among

Table XXIII

**EMPHASIS ON MANAGERIAL REQUIREMENTS AND THE IMPORTANCE OF THESE  
REQUIREMENTS TO RESEARCH PERSONNEL, BY LENGTH OF EMPLOYMENT AT TIROS**

Managerial Requirement Index <sup>a</sup> -- All Managers in Survey 3 (N = 44)		Employee Importance Index, <sup>a</sup> by Length of Employment				
		Initial Period	Adjustment Period		Stable Period	
		Less than 1 Year Employment (N = 47)	From 1 to 3 Years Employment (N = 72)	From 3 to 5 Years Employment (N = 82)	From 5 to 10 Years Employment (N = 65)	Over 10 Years Employment (N = 26)
Selling research ideas to prospective clients	92	70	69	57	60	51
Keeping up-to-date on new scientific developments	176	164	152	163	166	151
Having available adequate technical assistance	133	131	154	137	161	146
Publishing research findings in addition to Tiros reports	133	101	95	90	91	59
Helping clients implement Tiros research	104	105	96	61	79	74
Exercising a large degree of freedom in choice of research assignments	150	137	137	140	140	118
Doing research that contributes to scientific knowledge	157	123	132	157	138	130
Doing research that helps solve problems in industry or government	161	140	144	132	127	138
Seeking promotion within a research field	143	127	132	132	121	120
Seeking promotion into management positions at Tiros	100	77	91	97	65	74

Note: All data in this table are from Survey 3.

a. The calculation of these indexes is explained in footnote b in Table III (index can vary between 0 and 200).



research personnel. It is not the principal criterion of accomplishment at Tiros, as is often the case in many university, and even in some industrial, research contexts. Therefore, over time, incentives for entrepreneurship and professional or scientific productivity decrease. An individual researcher is rewarded most effectively for a minimal standard of performance entailing the maintenance of sold time on projects under his control; he is not rewarded to a similar degree for continued efforts to "sell" additional research projects or to publish the results of his effort. This is perhaps the heart of the dilemma faced by management in an organization like Tiros--how continuously to stimulate entrepreneurship and scientific productivity under conditions of an organizational system based upon contract research that increasingly tends to discourage such activities over time.

Pattern Two revealed by data for other items in Table XXIII tends to show a curve of emphasis in employee responses that is similar to the curve of employee job satisfaction and organizational identification revealed in Table XXII. This is the case for "seeking promotion within a research field," "seeking promotion into management positions at Tiros," "doing research that contributes to scientific knowledge," and "exercising a large degree of freedom in choice of research assignments." Initially, employee interest in these three items tends to be moderate or low, then increases during the adjustment period when employees are actively considering jobs elsewhere, and finally begins to decrease either earlier or later during the more stable period of employment. These findings are consistent with other data, cited earlier, indicating that research personnel in the adjustment period are more likely to emphasize the importance of "getting ahead in a job." It is also understandable that doing basic research might be more likely to result in a reputation that makes one more transferable to other organizations than is applied research--hence, the greater amount of emphasis upon basic research in this adjustment period.

Other data in Table XXIII reflect alternate variations in emphasis not associated with length of service in any discernably meaningful way. Items in this category include: "keeping up-to-date on new scientific developments"; "having available adequate technical assistance"; "helping clients implement Tiros research"; and "doing research that helps solve problems in industry or government." Apparently factors other than socialization constitute the primary determinants of employee attitudes regarding these items.

### Differential Socialization

Socialization, however, does not necessarily have the same effects for different types of personnel at Tiros. For example, with regard to entrepreneurship, Table XXIV shows that research personnel recruited from academic institutions do not show the same pattern of development as personnel recruited from private industrial firms; the importance of "selling research ideas to prospective clients" actually increases among academic personnel in the stable period of employment compared with those in the adjustment period. Similarly, individuals with no graduate degrees in their educational backgrounds are also slightly more likely to stress the importance of entrepreneurship in the stable period of employment than in their adjustment periods. Among employees in all other categories shown in Table XXIV, there is less emphasis upon entrepreneurship in their stable employment periods than in their adjustment periods.

Although the numbers of personnel in these categories are certainly too small for definitive conclusions to be made without further information on similar categories of personnel in other organizational contexts, the data available here appear to suggest that "selling research ideas to prospective clients" may mean different things to different categories of personnel. To many--perhaps most--research scientists it may appear to be a way to enhance one's connections with people outside the organization who might aid the individual in getting a research job elsewhere. On the other hand, many research scientists appear to feel that entrepreneurship becomes a burden that they would rather shift to the shoulders of others (e.g., management or research promotion and sales specialists) as they become committed to an organization during their stable period of employment--hence, the greater stress upon entrepreneurship in the adjustment period compared with the stable period among most research scientists.

Among persons recruited from academic institutions, however, entrepreneurship is apparently not perceived so much as a means to increase one's job mobility from one organization to another, but, rather, a normal concomitant of job requirements for researchers who are trying to be successful in a research environment that depends upon individual entrepreneurship. They are more likely to have accepted entrepreneurial activities as a "way of life" which is common both to their academic backgrounds and to their Tiros experiences. Thus, management hiring of research personnel from academic backgrounds appears to be more likely to support the expectation that socialization will increase an entrepreneurial orientation among research personnel.

Table XXIV

**IMPORTANCE OF "SELLING RESEARCH IDEAS TO PROSPECTIVE CLIENTS"  
AMONG RESEARCH PERSONNEL OF DIFFERENT BACKGROUNDS  
BY LENGTH OF EMPLOYMENT AT TIROS**

<u>Background of Personnel</u>	<u>Employee Importance Index<sup>a</sup> during:</u>	
	<u>Adjustment Period (from 1 to 5 years of employment)</u>	<u>Stable Period (from 5 years of employment onward)</u>
<b>Source of recruitment</b>		
Academic institution (N = 19/22) <sup>b</sup>	59	63
Private industry (N = 43/50)	62	58
<b>Highest academic degree</b>		
Doctor's degree (N = 23/24)	70	43
Master's degree (N = 45/49)	69	61
No graduate degree (N = 37/46)	58	61
<b>Age category</b>		
29 years or under (N = 35/9)	49	33
30 to 39 years (N = 42/73)	67	57
40 years or over (N = 28/38)	81	65

Note: All data in this table are from Survey 3.

- a. For the calculation of these indexes see footnote b in Table III (index can vary between 0 and 200).  
b. The first number is the N for column 1; the second number is the N for column 2.

Research Personnel with less professional "face validity" in terms of advanced academic degrees may attribute less advantage to entrepreneurial activities from a labor mobility standpoint, but more advantage to it as a means for controlling one's future as one becomes more committed to a particular organizational context. (Ph.D.'s, by virtue of this diploma, may be able to command managerial respect and to inhibit management from certain forms of control more easily than can personnel who do not hold advanced degrees.) In this light, it does not seem inconsistent that non-advanced-degree holders may be more prone to place more emphasis upon entrepreneurship over longer periods of time in an organization like Tiros. Socialization is not necessarily the same for different kinds of employees--it is a differential process.

This fact is also demonstrated in Table XXV. There it is shown that very young employees (those under 30 years old) and researchers recruited from academic sources are more likely to stress the importance of "publishing research findings in addition to Tiros reports" in their stable period of employment than in their adjustment periods. The reverse is true for most research personnel.

Two explanations may apply to these similar findings for very young persons and for those from academic institutions. It may be that more persons under 30, even though they have passed their five-year anniversaries at Tiros, may not really be committed to a career at Tiros, as are most employees who have remained for over five years. Chronological age, especially at extremely young ages and at the other extreme of older age, probably affects career perspectives as much as, or even more than, "organizational age" in the middle years of life. If true, then this might explain, in part at least, the reason why very young Tiros employees are even more interested in publishing research findings, even though they have passed into what would be a stable period of employment for most older employees; they are still thinking seriously about transferring to other organizations and see publication as facilitating their job mobility.

In contrast, we may recall that publication appears to be more a "way of life" that has been deeply ingrained in the behavior patterns of personnel with experience in conducting research in academic institutions. Publication is not merely a means of increasing one's job mobility--although this is certainly one important aspect of the incentive to publish--but it is also a means for retaining all-important professional status in academic circles. This aspect is also likely to be of special importance to Ph.D. research personnel, insofar as they desire to retain their professional standing among colleagues outside their

Table XXV

**IMPORTANCE OF "PUBLISHING RESEARCH FINDINGS" AMONG  
RESEARCH PERSONNEL OF DIFFERENT BACKGROUNDS, BY LENGTH OF EMPLOYMENT  
AT TIROS**

<u>Background of Personnel</u>	<u>Employee Importance Index<sup>a</sup> during:</u>	
	<u>Adjustment Period (from 1 to 5 years of employment)</u>	<u>Stable Period (from 5 years of employ- ment onward)</u>
<b>Source of recruitment</b>		
Academic institution (N = 19/22) <sup>b</sup>	105	108
Private industry (N = 43/50)	114	62
<b>Highest academic degree</b>		
Doctor's degree (N = 23/24)	153	141
Master's degree (N = 45/49)	92	77
No graduate degree (N = 37/46)	71	51
<b>Age category</b>		
29 years or under (N = 35/9)	91	100
30 to 39 years (N = 42/73)	121	91
40 years or over (N = 28/38)	72	50

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**Note:** All data in this table are from Survey 3.

- a. For the calculation of these indexes see footnote b in Table III (index can vary between 0 and 200).
- b. The first number is the N for column 1; the second number is the N for column 2.

immediate organizational context. Thus, Table XXV shows that the decline in emphasis upon the importance of publication is proportionally less from the adjustment period to the stable employment period among those with doctor's degrees than among those with master's degrees, and among those with master's degrees than among those with no advanced degrees.

Here again then, we find that Tiros management is able to mitigate the degrading effects of socialization upon motivation to publish research findings by hiring a minority of research personnel who are of a background that is less likely to support this deleterious effect.

#### Socialization and Other Managerial Mechanisms: Summary

In this chapter and the preceding two chapters we have discussed the use of certain important managerial mechanisms (incentives, recruitment-displacement, and socialization) to attempt to bring individual perspectives into accord with managerial requirements. The data presented in these chapters have shown that Tiros management to date has not been able to use any of these three mechanisms in a completely effective way with regard to enhancing scientific productivity (as indicated by publication), especially, or to enhancing entrepreneurial activity on the part of Tiros research personnel. These constitute problems that are generally recognized by management, although the means available for their solution is not necessarily clearly perceived.

The research findings herein might suggest certain approaches to alleviate these problems--e.g., by seeking ways and means to use certain non-monetary incentives, such as more freedom to choose research assignments, more effectively; hiring a larger proportion of research personnel from academic rather than industrial backgrounds; and by attempting to distribute the use of incentives differently over time to avoid the deleterious affects of socialization upon interests in publication and entrepreneurship. There might be unanticipated consequences of such actions on the part of management, however, such as decreasing the effectiveness of Tiros to conduct certain types of applied research oriented toward very specific and immediate client interests. The diversity of goals in an organization like Tiros entails a common management dilemma--how to eat one's cake and have it too!

More research in other organizational contexts may be able to discover more effective solutions for this dilemma.

## VII ENTREPRENEURSHIP

As was pointed out in the previous three chapters, there are various mechanisms at the disposal of management to bring individual perspectives more into line with managerial requirements in complex organizations. However, influence flows both ways in relations between organizations and individual members. There are also mechanisms at the disposal of individuals to protect themselves from certain forms of managerial influence within organizational contexts. These protective mechanisms serve, over varying periods of time, as forces that may act to reshape the goals and requirements of organizations in directions that are more amenable to individual interests.

This chapter discusses one of the latter types of mechanism at the disposal of research scientists in research organizations. This is the process of research entrepreneurship, which may be described here as "selling ideas to prospective clients" in order to obtain financial sponsorship of research projects related to these ideas. Entrepreneurship has been viewed previously as a managerial requirement. In this chapter, it is discussed from a different standpoint--as a mechanism used by employees to adapt themselves to (or perhaps more accurately, to insulate themselves from) certain aspects of managerial control.

After a discussion of the development of this process in the context of Tiros, we shall investigate what kinds of individuals participate in various ways in entrepreneurial activities and how this participation affects their adaptations to their organizational environment.

### Entrepreneurship at Tiros

Entrepreneurial activity can be contrasted with bureaucratic activity.\* Bureaucratic activity may be described as the performance of

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\* Reinhard Bendix makes a somewhat similar distinction in Work and Authority in Industry (New York: Wiley, 1956). Commonly accepted descriptions of bureaucratic practices are contained in the works of Max Weber and interpretations of these works, such as Max Weber, The Theory of Social and Economic Organization, trans. by A. M. Henderson and Talcott Parsons (Glencoe, Ill.: Free Press, 1947); H. H. Gerth

formally specified job duties prescribed for a position within an administrative hierarchy of authority and responsibilities. Entrepreneurial activity, on the other hand, is oriented toward the development of new relations with a clientele outside the administrative hierarchy of the immediate organizational context. Bureaucratic activity is primarily inner-organization oriented; entrepreneurial activity is primarily outer-organization oriented. One emphasizes production; the other emphasizes sales.

Both seek ways to minimize risk and unpredictability in human behavior, but their approaches to the problem of risk and unpredictability are quite different. The bureaucratic solution is to absolve the individual of as much responsibility for organizational decisions as possible, by "pre-planning" actions to meet all conceivable alternatives, and by embodying these solutions in formalized regulations, rules, and guidance manuals. The entrepreneurial solution is to "stay loose," to place primary reliance in individual competence and training to cope with unexpected situations, and to free the individual, as much as possible, from limiting rules and regulations.

Entrepreneurial activities are sometimes found within bureaucratic contexts. The opposite is also true--organizations that are primarily conceived of as entrepreneurial can become bureaucratized in some of their functions over time. Wherever they are found, however, bureaucratic activities tend to emphasize the rational interdependence of functional units within an organization. In contrast, entrepreneurial activities tend to result in independence, or functional autonomy, of units within larger organizational contexts. Successful entrepreneurs are able to transfer their primary dependence from the immediate organization department that employs them to the individuals or organizations who constitute their clientele. It is this latter feature of entrepreneurship that lends it its special significance at Tirois.

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and C. Wright Mills, From Max Weber, Essays in Sociology (New York: Oxford Univ. Press, 1946); and Peter M. Blau, Bureaucracy in Modern Society (New York: Random House, 1956). Descriptions of entrepreneurial practices are found especially in the works of Harvard University economists, such as Joseph A. Schumpeter, Capitalism, Socialism, and Democracy, 4th ed. (London: George Allen & Unwin, 1952), and Arthur H. Cole, Business Enterprise in its Social Setting (Cambridge, Mass.: Harvard Univ. Press, 1959). An interesting analysis of bureaucratic compared with entrepreneurial patterns of child rearing is presented in Daniel R. Miller and Guy E. Swanson, The Changing American Parent (New York: John Wiley, 1958).



Although Tiros is fundamentally a bureaucratic type of organization in its administrative hierarchy and in its service units, it is certainly more of an entrepreneurial type of organization in its research departments and divisions. This fact is recognized by some, but not all, managerial personnel. Following are some examples of management recognition of this fact, drawn from a speech on "research entrepreneurship" by a Tiros division director:

I use "entrepreneur" deliberately because I believe that entrepreneurial spirit is a key ingredient in the success of each staff member, and in turn of Tiros as a whole. Like entrepreneurs, each staff member makes investment decisions and takes risks: the risk that a research approach or hypothesis is better than others that might be used; the risk that time spent on a certain proposal or thinkpiece is a good investment; the professional risk that a paper will be accepted for publication and will stand up under criticism; the risk that certain fellow team members on a project will do their share; the risk that the client will find your work responsive to his needs or, on occasion, that he will find your description of needed modifications to be persuasive. This sort of risk-taking takes self-reliance. Tiros decentralizes self-reliance to an unusual degree.

In contrast, the fact that entrepreneurship is not strongly emphasized by all managerial personnel was indicated previously in Table IV. Only 14% of the managerial personnel in the divisions included in Survey 3 thought that "selling research ideas to prospective clients" was generally desirable among research personnel.

On the other hand, 62% of the professional research personnel in Survey 3 indicated that they had, in fact, had considerable opportunity to sell research ideas to prospective clients. Some of these individuals, however, do not really appreciate this opportunity; they would rather have management itself take more direct responsibility for selling research contracts instead of having individual researchers take this responsibility (a more bureaucratic response), as is indicated in the following comments:

Increased liaison between Tiros and its prospective clients at a level other than that of the working scientist would free him to spend more of his time in actual research, instead of being engaged in project promotion.

Management should relieve the researcher from much of the responsibility for seeking out, contacting, and selling the potential client. They should let the researcher act more as a consultant to the promoter.

Management should aid project personnel in contacting a potential client for specific projects, preparing proposals, selling proposals, client relations if trouble develops in project conduct, and in follow-through to learn long-range results of project findings with the client.

Other comments, however, may be described as being more basically entrepreneurial in content, emphasizing the placing of individual responsibility upon research personnel for selling their research services to outside clients, as is indicated in the following comments:

Tiros should provide encouragement and even inducement for its research staff to engage in project promotion activities.

We should have all project leaders participate in all research contract negotiations so as to prevent under-pricing and to avoid missing major opportunities for projects that a non-scientist, unfamiliar with the state of the art, cannot see.

In selling research to a client, just who, how, when, and where the initial contact is made can set the climate of the whole project. Grandiose promises made by technically incompetent persons can get those who work on a project behind the eight-ball, as can an underestimate of the capabilities of the personnel. Does management really know the extent of ability and experience of individuals and lab groups (to be able to sell research contracts)?

We should make it more possible for project personnel to meet with sponsors of the research, or at least with scientists at the sponsoring agency.

Such an entrepreneurial attitude is not only found among many research personnel in independent research organizations, which depend primarily upon research contracts with outside organizations to maintain their institutional structure, but is also found in research laboratories in larger corporations, where research ideas must be "sold" to the management of production, marketing, and other functions within this larger corporation. Robert W. Avery has written:

It is significant that researchers . . . talk about the importance of "selling an idea." They use the language of the marketplace and they emphasize that the new graduate must become

fluent in two slightly different languages. The enculturated researcher reserves the esoteric vocabulary of his field largely for use with his colleagues. When he seeks to persuade his more business-oriented managers that they should share his enthusiasm for his projected work, he translates his technical abstractions into words that are less exact but more compelling to men who are not immersed, as he is, in the subtle problems of one narrow specialty. Especially, he stresses the economic potential of his idea, however remote it may be.\*

As mentioned earlier, however, not all research personnel at Tiros are basically interested in such entrepreneurial activity. Actually, responses to survey questionnaires made it possible to classify research personnel in Survey 2 and in Survey 3 into four categories: (1) satisfied entrepreneurs--those who indicate that the "opportunity to sell research ideas to prospective clients" is important to them, personally, and moreover, that they have had ample opportunity to do this at Tiros; (2) frustrated entrepreneurs--those who similarly indicate that opportunity to sell research ideas is important to them, but who feel that they have not had ample opportunity to do this at Tiros; (3) reluctant entrepreneurs--those who said that they have had opportunity to sell research ideas to prospective clients at Tiros but who would prefer not to do it; and (4) non-entrepreneurs--those who apparently have had neither the desire nor the opportunity to sell research ideas while at Tiros.

Figure 4 shows these four categories of entrepreneurship, along with the numbers and proportions of research personnel in each category from each survey population at Tiros. It may be seen that there was a larger proportion of personnel who were satisfied entrepreneurs in the Survey 2 population, whereas there was a slightly larger proportion of reluctant entrepreneurs in the Survey 3 population. Also, it may be noted that frustrated entrepreneurs were the smallest group in Survey 3, whereas non-entrepreneurs were the smallest group in Survey 2.

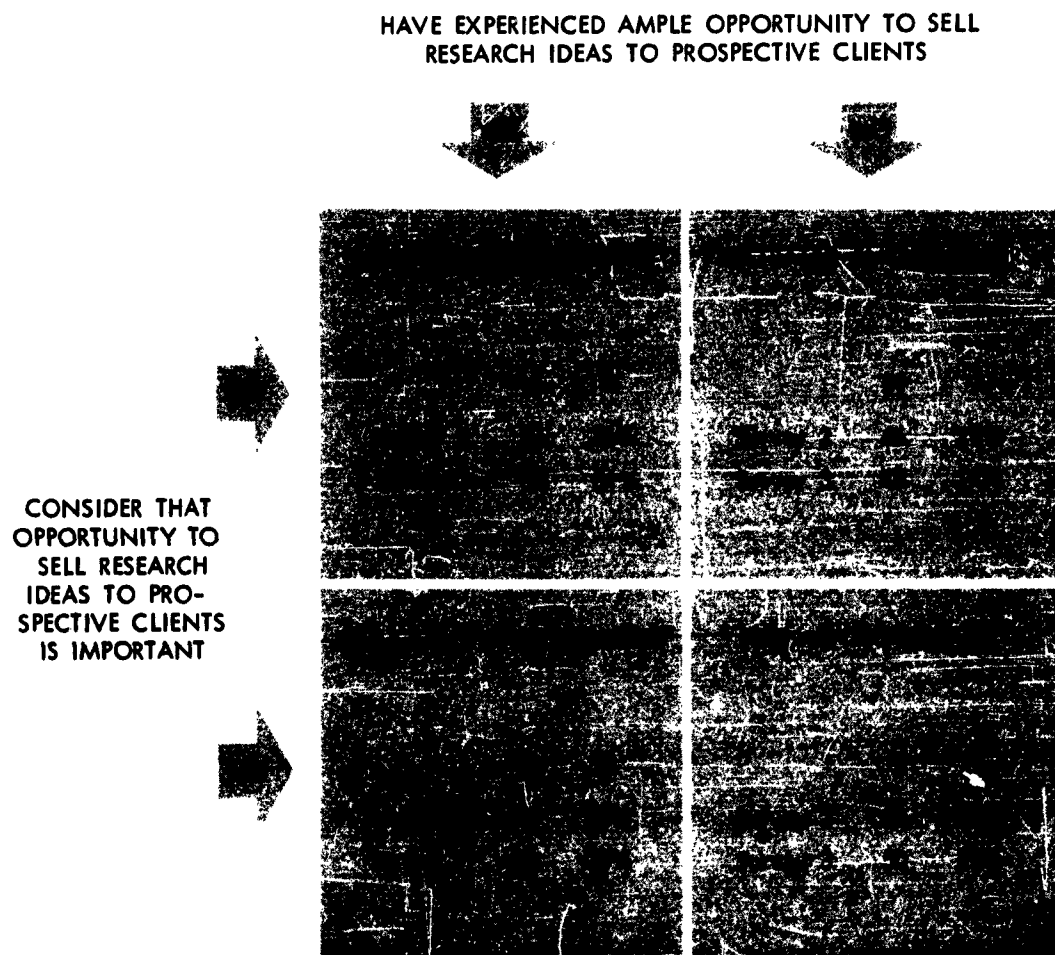
The discussion in the remainder of this chapter is concerned with an examination of the characteristics of these different kinds of entrepreneurs and relations between these patterns of entrepreneurial activity and professional productivity, general job satisfaction, and the interests of the research scientists involved.

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\* Avery, op. cit., p. 22.

FIGURE 4

DIFFERENT TYPES OF RESEARCH ENTREPRENEURS AT TIROS



### Characteristics of Entrepreneurs

Table XXVI provides information regarding certain important background and status characteristics of different kinds of research entrepreneurs at Tiros. Data in this table show, for example, that research personnel in Survey 3 with master's degrees are somewhat more likely to be interested in selling research ideas than individuals with doctor's degrees, since there are proportionately more master's degree holders who are classified as satisfied entrepreneurs or frustrated entrepreneurs than doctor's degree holders in these same categories. This fact was noted earlier in Chapter V (Recruitment and Displacement). Here in Table XXVI, however, we can see that those with doctor's degrees are more likely to be reluctant entrepreneurs--that is, successful salesmen of research ideas, but often more interested in other production and transmission facets of research activities. Personnel who do not hold advanced degrees, in turn, are slightly more likely to be non-entrepreneurial than those with advanced degrees, as might be expected. Actually, many non-advanced-degree holders at Tiros are more often employed in project assistance tasks, rather than in project leadership or direction, and are therefore not as much expected to promote new project acquisition themselves.

There is a similar pattern of findings for the personnel in Survey 2 according to their educational level. However, there appears to be some difference between personnel in Survey 2 and Survey 3 in the extent of interest in entrepreneurial activities among those recruited from academic and those from industrial backgrounds. Among those in the Engineering Technology divisions and Systems Research Division A (Survey 3), personnel from academic institutions were slightly more likely to consider entrepreneurial activity important than those from industrial backgrounds. In contrast, among those in the Business Research Department and Systems Research Division B (Survey 2), personnel from industrial firms were slightly more likely to consider entrepreneurial activity important than those from academic backgrounds.

This suggests that there may be a considerable difference in the characteristic way of life of what could be broadly described as social science activities in industry and the university, compared with engineering activities in these two contexts. Engineers may be more established in industrial research, development, and production activities and therefore may have to engage in less effort to "sell" their services to higher management there than do less-well-established social scientists. In turn, the reverse may be true in many university situations, where activities in schools and departments of engineering could be considered less secure than more traditional scholarly pursuits of social scientists and even-more-established physical scientists.

Table XXVI

## CHARACTERISTICS OF DIFFERENT TYPES OF RESEARCH ENTREPRENEURS

	<u>Satisfied</u> <u>Entre-</u> <u>preneurs</u>	<u>Frustrated</u> <u>Entre-</u> <u>preneurs</u>	<u>Reluctant</u> <u>Entre-</u> <u>preneurs</u>	<u>Non-</u> <u>Entre-</u> <u>preneurs</u>
<b>Highest academic degree</b>				
Doctor's degree (N = 53)	32%	8%	51%	9%
Master's degree (N = 115)	33	17	31	18
No advanced degree (N = 96)	28	22	25	25
<b>Source of recruitment</b>				
Academic institution (N = 17)	35	21	29	15
Industrial company (N = 33)	28	18	34	20
<b>Age category</b>				
29 years or under (N = 57)	26	18	23	33
30 to 39 years (N = 133)	29	17	38	17
40 years or over (N = 74)	38	18	32	12
<b>Length of Tiros employment</b>				
Less than 1 year (N = 41)	32	20	27	22
From 1 to 5 years (N = 132)	30	18	33	19
Over 5 years (N = 90)	33	13	36	18

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Note: All data in this table are from Survey 3.

Thus, it may be the engineers, especially, who must become entrepreneurs if they are to survive in a university, and it may be the social scientists, especially, who must become entrepreneurs if they are to survive in industry. In an organization that is solely in the research business like Tiros, however, all disciplines and research fields are equally responsible for seeking and sustaining client support for their research efforts.

It appears also that research personnel, over time in their professional careers, tend to develop entrepreneurial abilities to an increasing degree--at least up into the age 40 period of a middle career. Thus Table XXVI shows that research personnel over 40 are less likely to be non-entrepreneurs. In fact, it is probably true that it is the entrepreneurs who are more likely to survive as professional researchers; non-entrepreneurs apparently tend to transfer into other occupations.

This does not mean, however, that those with more experience in research activities necessarily develop a greater liking for entrepreneurship, even though they may recognize it in terms that some would describe as "a necessary evil" or "occupational hazard," and even though they may develop considerable entrepreneurial skills over time. In fact, Table XXVI shows that researchers with over five years of employment at Tiros--who have thus generally passed into a stable period of career adjustment in the organization--are more likely to be reluctant in their entrepreneurship than those with less service.

One can gain a clearer picture of some general personality characteristics to be found among these different kinds of entrepreneurs by examination of the attitudinal data shown in Table XXVII. Here we can see that satisfied or frustrated entrepreneurs are most likely to be achievement-oriented in relation to their work, whereas reluctant entrepreneurs or non-entrepreneurs are most likely to be interested in job security rather than in "getting ahead." More specifically, those who are interested in selling research ideas are also more likely to be interested in eventual movement into research management positions.

Furthermore, Table XXVII suggests that satisfied entrepreneurs are most likely to be self-involved in their work activities--thus carrying them over into outside-work affairs. Non-entrepreneurs are least likely to do this; they can more easily distinguish between work and non-work obligations and actions--a characteristic of bureaucratic, in contrast to entrepreneurial, patterns of behavior.

Table XXVII

WORK ATTITUDES OF DIFFERENT TYPES OF RESEARCH ENTREPRENEURS

	Satisfied Entre- preneurs (N = 82)	Frustrated Entre- preneurs (N = 45)	Reluctant Entre- preneurs (N = 88)	Non- Entrepreneurs (N = 50)
Want to "get ahead in a job" rather than to have a "steady and dependable job"	82%	78%	55%	66%
Want to go into research management	55	47	30	36
Enjoy "talking about work off the job very much"	50	38	34	28
Taking everything into account, satisfied with job in general	69	58	77	76

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Note: All data in this table are from Survey 3.

At the same time, Table XXVII shows that non-entrepreneurs and reluctant entrepreneurs are about as likely to be satisfied with their jobs in general as satisfied entrepreneurs. Thus, personal job involvement and work motivation is more likely to be associated with entrepreneurship, but entrepreneurs are not any more less likely to be satisfied with their jobs in general than bureaucrats. The only category of entrepreneurs who are more likely to be unhappy in general about their job situations are those who desire to be entrepreneurial but who perceive that this desire has been frustrated in their present environment.

In summary to this point, it appears that more successful research entrepreneurs in an environment such as that offered at Tiros are more likely to have come from backgrounds that stimulated their entrepreneurial abilities (e.g., academic environments for research engineers; industrial



environments for social scientists) and that allowed them to develop over a considerable period of research experience. The ability to sell research ideas successfully is not quickly acquired. Older and more experienced researchers are likely to be more proficient at it, although they are also more likely to tire of it. Also, ambitious individuals who lack the very highest credentials in the research field (i.e., a Ph.D. degree) are also likely to be more consciously entrepreneurial in their research activities--they must "run scared" to keep up with the head start that a doctor's degree may give in entrepreneurial competition. Finally, since entrepreneurial activities do involve a strenuous, self-involved competition among ambitious, highly-motivated individuals, these individuals are likely eventually to seek ways to secure the advantage and control they have achieved through entrepreneurship by moving into research management. Successful entrepreneurship, in turn, in an organization like Tiros provides the best basis for status advancement into managerial positions.

Before moving into management, however, a successful research entrepreneur secures a considerable degree of control over his work environment already. We may now turn to a discussion of how entrepreneurship facilitates the control of a researcher over his environment.

#### Consequences of Entrepreneurship

Two consequences of entrepreneurship for the adaptation of individual scientists to an organization like Tiros may be examined. These include (1) consequences for what were described in Chapter III as structural-conflict problems--that is, problems arising from discrepancies between what employees desire and limitations inherent in the structure of the organization; and (2) consequences for management-employee conflict problems--that is, problems arising from differences between managerial requirements and employee interests.

With regard to structural conflict problems, it will also be recalled from Chapter III that the greatest discrepancies between employee interests and experiences at Tiros concern funds acquisition, information acquisition, and freedom in project assignments. The larger proportions of Tiros employees expressed the feeling that they do not have sufficient research funds to support their individual research interests, sufficient opportunity to keep up-to-date on new scientific developments in their fields of study, and as much freedom in project assignments as they might desire.

How does participation in entrepreneurial activities affect these problems?

Data relevant to this question are shown in Table XXVIII. This table shows that for the individuals who participated in Survey 3, there was the least discrepancy between ratings of importance and ratings of experience for reluctant entrepreneurs. For the individuals who participated in Survey 2, there was the least discrepancy between ratings of importance and ratings of experience for satisfied entrepreneurs. For personnel in both parts of Tiros, therefore, it appeared that entrepreneurial activity was most likely to be associated with a reduction in the discrepancy between desires and accomplishments--satisfied entrepreneurs and reluctant entrepreneurs, by definition, are those who both report that they have, in fact, been able to sell research ideas to prospective clients. Their attitudes toward entrepreneurship differ, however. As was pointed out previously, the Engineering Technology and Systems Research Personnel in Survey 3 are more likely to have come into Tiros from industrial firms, where entrepreneurial activity was not as strongly emphasized or valued as among the broad range of social scientists who constituted most of the Survey 2 population. Reluctance with regard to entrepreneurship is more a norm in the occupational culture of the research engineers included in Survey 3.

In both survey populations within Tiros, however, it may also be noted that the greatest discrepancies between desires and achievements on all three items were to be found among the frustrated entrepreneurs. These are the individuals who tend to have a high degree of desire for keeping in touch with scientific developments in their fields, having sufficient funds to support their individual research interests, and having freedom in project assignments, but they have been almost as unable to achieve these desires at Tiros as they have been unable to sell research ideas to prospective clients. The finding, shown previously in Table XXVII, that frustrated entrepreneurs are least likely to be satisfied with their jobs in general becomes even more meaningful in the light of these additional findings.

A word may be said here about the data for non-entrepreneurs, as shown in Table XXVIII. It may be seen in this table that in almost all cases (except for Survey 2 non-entrepreneurs with regard to information acquisition), the non-entrepreneurs tended to have a lower level of desire for the items shown, and therefore were more easily satisfied without entrepreneurial effort. This is in accord with the indications shown previously in Table XXVII that non-entrepreneurs are likely to be less ambitious and job-involved than more entrepreneurial persons, and is also in accord with the interpretation that these individuals are more bureaucratic in their orientation.

Table XXVIII

**IMPORTANCE ATTACHED TO VARIOUS WORKING CONDITIONS AND  
EXPERIENCE OF THESE CONDITIONS AMONG  
DIFFERENT TYPES OF RESEARCH ENTREPRENEURS**

	(A) Employee Importance Index <sup>a</sup>	(B) Employee Experience Index <sup>b</sup>	Discrepancy (A) - (B)
<b>Opportunity to keep up-to-date on new scientific developments in my field</b>			
Satisfied entrepreneurs	171 <sup>c</sup> 159 <sup>d</sup>	96 102	75 57
Reluctant entrepreneurs	153 152	110 44	43 108
Frustrated entrepreneurs	180 174	65 51	115 123
Non-entrepreneurs	136 160	82 62	54 98
<b>Having sufficient funds to conduct the kind of research I want to do</b>			
Satisfied entrepreneurs	148 152	67 81	81 71
Reluctant entrepreneurs	139 141	76 41	63 100
Frustrated entrepreneurs	156 134	3 15	153 119
Non-entrepreneurs	118 117	48 35	70 82
<b>Having a large degree of freedom in selecting research assignments</b>			
Satisfied entrepreneurs	147 130	95 102	52 28
Reluctant entrepreneurs	133 153	82 62	51 91
Frustrated entrepreneurs	143 123	29 6	114 117
Non-entrepreneurs	122 109	32 9	90 100

a. For the calculation of these indexes see footnote b in Table III (index can vary between 0 and 200).

b. For the calculation of these indexes see footnote b in Table VI (index can vary between -100 and +200).

c. Upper number--Survey 3.

d. Lower number--Survey 2.

Entrepreneurship not only serves as a mechanism to relieve structural conflict problems for employees, but it also serves at Tiros to ameliorate the most sizable management-employee discrepancy problem--that is, with reference to the managerial requirement that the rate of professional publication be increased among Tiros staff members, as was indicated earlier in Chapter III. A considerable proportion of Tiros employees do not seem to be as interested in professional publication and actually do not publish as often as management would desire.

In this regard, Table XXIX shows that the rate of professional publication tends to be highest among satisfied entrepreneurs and to be lowest among non-entrepreneurs in both Tiros surveys. Again, however, we can see that the publication rate is almost as high among reluctant entrepreneurs as among satisfied ones in the Survey 3 population. This again may simply reflect the fact that it is apparently more in accord with the behavioral norm to be reluctant about entrepreneurship among the research engineers and systems researchers included in this grouping.

Table XXIX

PROFESSIONAL PRODUCTIVITY AMONG  
DIFFERENT TYPES OF RESEARCH ENTREPRENEURS

	Satisfied Entre- preneurs (N = 82) <sup>a</sup> (N = 58) <sup>b</sup>	Reluctant Entre- preneurs (N = 88) <sup>a</sup> (N = 32) <sup>b</sup>	Frustrated Entre- preneurs (N = 45) <sup>a</sup> (N = 46) <sup>b</sup>	Non- Entrepreneurs (N = 50) <sup>a</sup> (N = 23) <sup>b</sup>
Have produced 1 or more professional publications based upon Tiros research	52% <sup>a</sup> 34% <sup>b</sup>	42% 24%	19% 25%	24% 9%
Have produced 4 or more professional publications based upon Tiros research	10% 10%	13% 6%	4% 4%	0 0
Average number of years of Tiros employment to produce 1 publication	3.5 4.7	3.8 7.0	7.2 6.2	10.5 35.0

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a. Survey 3.

b. Survey 2.

Nevertheless, the data in Table XXIX indicate strongly that successful entrepreneurship--the experience of having sold research ideas to prospective clients--is an important prerequisite for professional productivity in an organization like Tiros. Those who do not sell are not as likely to be able to publish--they do not have the financial resources and the data upon which they can base technical publications under their own names.

Furthermore, the indication is not as strong, but it is at least suggested by Table XXIX, that financial resources are not all that lead to professional productivity. Publications are also more likely to be produced by the ambitious scientists, the achievement oriented, the individuals who not only sell research ideas to prospective clients but desire to do more selling and consider it an important, if not essential, aspect of their work activities.

In sum, then, research entrepreneurs may be said to be the doers in practically all aspects of the research activities that are fundamental to the survival and growth of an organization like Tiros.

## VIII NON-FORMALIZED RESEARCH

As was indicated earlier, the research contract between Tiros and some outside organization or individual, known as the research client, is the keystone of the financial, social, and organizational structure of Tiros. It embodies the formal requirements and structure of research activities. Research contracts often cut across sections, divisions, and even departments in the organizational structure, involving individual researchers from a variety of disciplines and contexts on individual projects. Thus, the structure of project teams--ever changing as new projects are established and old projects completed--is superimposed upon the formal administrative structure, and a complex web of individual associations and obligations transcends the formal hierarchy of authority.

Administrators may have something to do with project assignments--for example, with regard to research contract opportunities that come to Tiros initially unassigned to individuals or groups, in contrast to those initiated directly by the contacts of individual research entrepreneurs with outside clients--but they have little to do with the day-to-day administration of research projects within the contract mechanism. At Tiros, the project director or project leader is king, being responsible, ordinarily, for the initial design of the research, for its conduct and associated data collection and analysis, for interpretation of the research findings and their embodiment in a suitable report for the client, and--what is most important here--for the assignment of tasks to other professionals working on the project and for review of their work with regard to project objectives. Thus, a successful entrepreneur who actually sells research ideas to some prospective client ordinarily becomes project leader and thereby gains a high degree of control over his working environment, at least for the duration of that research contract.

Not all researchers are successful entrepreneurs, however, and those that are, are not necessarily successful all the time. This leads to a demand for alternative mechanisms to enable the individual research scientist to gain some measure of control over his environment within the context of research contracts that he, himself, does not control.

An important mechanism of this type is described here as "non-formalized research"--referring to research activities of special interest to the researcher himself, undertaken within the general context of

formal research contract specifications but not expressly described in these specifications. This chapter includes a discussion of how non-formalized research manifests itself at Tiros and its principal consequences, especially for professional productivity in more applied research situations.

#### Non-formalized Research at Tiros

A variety of non-formalized research activities can take place within the context of formalized research contracts. These sometimes include such activities as keeping up-to-date on new scientific findings, the conduct of basic research within applied research contracts, and technical publications writing. Because such activities are not always recognized in formal contract specifications, they are sometimes referred to as "bootlegging" among research personnel. As one Tiros manager put it in a discussion with his staff:

. . . we need to exercise our professional abilities. We have to make time to write papers and attend conferences. We have to keep our professional tools sharp.

Other Tiros research scientists have said:

(Bootlegging is) important to our staying in this business. I don't like the term, but one shouldn't feel guilty about it. It's part of our job and quite easy to manage.

I've not done any bootlegging because I've been able to obtain support for research activities in my field of interest. But if I didn't have this support, I'd probably be doing some bootlegging.

The term "bootlegging" is somewhat misleading, however, because the activity may not involve anything detracting from or contrary to research contract specifications. In fact, most research contracts are loosely worded enough to allow a considerable degree of leeway in individual behavior that is still within the bounds of project objectives. Sometimes a client himself encourages broad interpretations and variations in research activities out of a desire to stimulate research creativity and contributions to general scientific interests beyond the immediate interests of an individual research client. Such situations are indicated in the following comment:

We have done a little bootlegging, partly on our own. We have good relations with our present client because we have done a lot of work for them and they like our work. . . . They often call us and ask us informally to do something that isn't specifically in the contract. . . . The latest contract renewal was written somewhat loosely just to allow for this sort of thing.

The inclination to engage in non-formalized research activities is stimulated among many researchers by a desire to do more basic research of fundamental scientific significance within the context of applied research contracts. Such a desire is indicated by the following remarks:

Basic research ought to be encouraged in all fields. A portion of each professional researcher's time in this organization ought to be left free for it.

Tiros should try to obtain research support in the direction of more basic and less applied research, encouraging the most astute type of scientific communication by means of technical publications, etc.

As was shown previously in Table III, management tends to emphasize basic research as much as applied research in the Engineering Technology divisions, but there is less managerial emphasis upon basic research and more upon applied research in the Systems Research and Business Research Divisions. Table XXX shows a similar pattern for employee interests in basic research compared with applied research in the different Tiros divisions--interest in basic research was relatively more frequent in the Engineering Technology divisions, and interest in applied research predominated in the Systems and Business Research divisions. Table XXX also shows that a tendency toward non-formalized research was correspondingly higher in the Engineering Technology divisions, where the value of basic research is more emphasized, than in the other divisions.

There was only a slight tendency for any background factors to be related to engaging in non-formalized basic research within applied research contracts among research personnel at Tiros. Individuals with higher levels of academic training (e.g., those with doctor's degrees) and those recruited from academic backgrounds were slightly more likely to say that they had participated in this type of non-formalized research "often." There was, however, a marked tendency for more frequent participation among individuals on larger research contracts--that is, those funded at larger levels, as is shown in Table XXXI for the Tiros sample



Table XXX

**EMPLOYEE INTEREST IN BASIC AND APPLIED RESEARCH ACTIVITIES  
AND PARTICIPATION IN NON-FORMALIZED RESEARCH ACTIVITIES IN FIVE DIVISIONS**

	Engineering Technology Division A (N = 80)	Engineering Technology Division B (N = 100)	Systems Research Division A (N = 64)	Systems Research Division B (N = 60)	Business Research Department (N = 103)
Interested in opportunity to do re- search that contributes to scien- tific knowledge	49% 141 <sup>a</sup>	54% 149	38% 121	25% 115	20% 86
Interested in opportunity to do re- search that helps solve problems in industry or government	48% 141	37% 122	78% 173	73% 173	76% 174
Participate in non-formalized re- search "often" or "sometimes" <sup>b</sup>	79%	67%	30%	50%	37%

- 
- a. For calculation of these indexes see footnote b in Table III (index can vary between 0 and 200).  
b. In response to the question "Have you found that conducting basic or fundamental research activities within applied research contracts is practiced in your type of research?"

for which these data were available. In this table we may see, for example, that 42% of the participants in larger projects reported that conducting basic or fundamental research activities informally within applied research contracts is "very often" engaged in, whereas only 20% of those on small projects said the same thing.

Table XXXI

PROPORTIONS OF RESEARCH PERSONNEL REPORTING DIFFERENT  
FREQUENCIES OF NON-FORMALIZED RESEARCH ACTIVITIES  
BY SIZE OF RESEARCH PROJECTS

Frequency of Non-formalized Research	Size of Research Project <sup>a</sup>		
	Large (N = 59)	Medium (N = 51)	Small (N = 30)
"Very often"	42%	20%	20%
"Sometimes"	29	15	25
"Very seldom" or "never"	20	54	54

- 
- a. This question was asked only on Survey 2. These data are in response to the question, "What size projects have you worked on for the most part during the past twelve months at Tiros?" The response categories were in terms of annual project funds. For the purposes of this table, "large" projects may be considered to be those requiring over two man-years of effort annually, "medium" projects may be considered to require about one man-year of effort, and "small" projects may be considered to require less than one man-year of effort.

The flexibility and opportunity for non-formalized research that is provided in larger research contracts may explain, in large part, the desire that many researchers express to have more large and continuous contracts at Tiros:

We should find means to obtain large support commitments from government and industry.

The organization should put gradual pressure on government sponsors to improve their research sponsorship policy--mainly so that research contracts can be larger and longer, and not so completely governed by contract specifications in their technical aspects.

There are too many small projects--which means that there is too much report writing, proposal writing, and selling activity by the average professional staff member.

The last statement suggests an examination of the relation between research entrepreneurship and non-formalized research activities. Such an examination revealed no consistent relationship between entrepreneurship and non-formalized research; in other words, non-formalized research was reported with approximately equal frequencies among the various categories of entrepreneurs discussed in the preceding chapter. However, further examination of the Survey 2 data for various kinds of entrepreneurs revealed that satisfied entrepreneurs were more likely to be employed on smaller projects, whereas non-entrepreneurs were more likely to be employed on large projects, with the other categories in between in this pattern.

These findings, considered together, suggest that there may indeed be a relationship between these two protective mechanisms, non-formalized research and entrepreneurship, that is mediated by project size. Most successful entrepreneurs establish themselves as project leaders of relatively small projects. Unsuccessful entrepreneurs, however, lacking perhaps the motivation, skill, and/or opportunity to become project leaders themselves, must become assistants on projects under the direction of others. Where they must become project assistants, rather than leaders, they tend to favor larger projects, because it is on larger projects that they apparently have more opportunity to practice a "second best" defense mechanism--engaging in non-formalized research. Therefore, non-formalized research may be, in a sense, a "poor man's form of entrepreneurship."

This conclusion is substantiated somewhat further by data shown in Table XXXII for both the Survey 2 and Survey 3 populations, indicating that those who more often participate in non-formalized research are more likely to be those who (1) attach more importance to having sufficient funds to support their own research interests, but (2) are not as likely to have such funds at their own disposal (as successful entrepreneurs

would), and therefore (3) experience more deprivation in their desire for financial support for their research interests.

Table XXXII

DEGREE OF IMPORTANCE ATTACHED TO SUFFICIENCY OF  
RESEARCH FUNDS AND DEGREE OF EXPERIENCE OF SUFFICIENCY OF  
RESEARCH FUNDS AMONG DIFFERENT CATEGORIES OF  
PERSONNEL ENGAGING IN NON-FORMALIZED RESEARCH ACTIVITIES

		Sufficiency of Research Funds <sup>a</sup> (Indexes)		
		(A) Employee Importance Index <sup>b</sup>	(B) Employee Experience Index <sup>c</sup>	Discrepancy A - B
Non-formalized research-- very often	(N = 62) <sup>d</sup>	152	45	107
	(N = 31) <sup>e</sup>	165	48	117
Non-formalized research-- sometimes	(N = 108)	146	64	82
	(N = 52)	144	45	90
Non-formalized research-- seldom or never	(N = 90)	126	54	72
	(N = 59)	131	50	81

- 
- a. The specific item for which data are shown in this table is "Having sufficient funds to conduct the kind of research I want to do."  
b. For the calculation of these indexes, see footnote b in Table III (index can vary from 0 to 200).  
c. For calculation of these indexes, see footnote b in Table VI (index can vary from -100 to +200).  
d. Upper numbers--Survey 3.  
e. Lower numbers--Survey 2.

### Consequences of Non-formalized Research

Participation in non-formalized research does not apparently have any consequences for the adaptation of employee interests or for the general job satisfaction of research employees at Tiros--those who often participate in non-formalized research are no more or less likely to be satisfied with their jobs in general than are those who participate sometimes or never. However, non-formalized research does apparently have important consequences for professional productivity. Those who say that basic or fundamental research activities are very often conducted informally within applied research contracts in their research areas are more likely to have produced publications, and have a higher rate of publication productivity over time, than those who seldom or never engage in this practice, as may be seen for both Survey groups in Table XXXIII. The rate of production of publications is in between these two extremes for occasional or sometime participants among Tiros employees in both surveys.

Table XXXIII

#### PROFESSIONAL PRODUCTIVITY AMONG DIFFERENT CATEGORIES OF PERSONNEL ENGAGING IN NON-FORMALIZED RESEARCH ACTIVITIES

	Non-formalized Research-- Very Often (N = 62) <sup>a</sup> (N = 31) <sup>b</sup>	Non-formalized Research-- Sometimes (N = 108) (N = 52)	Non-formalized Research-- Seldom or Never (N = 90) (N = 59)
Have produced 1 or more professional publications based upon Tiros research	49% <sup>a</sup> 38% <sup>b</sup>	43% 27%	25% 17%
Have produced 4 or more professional publications based upon Tiros research	8% 13%	11% 4%	4% 3%
Average number of years of Tiros employment to produce 1 publication	3.0 3.9	4.2 8.4	7.2 10.9

a. Upper numbers--Survey 3.

b. Lower numbers--Survey 2.

Therefore, these data suggest that non-formalized research, as defined herein, is an important factor in professional productivity among scientists in applied research situations. It is reportedly engaged in by 65% of the engineering and systems research personnel in Survey 3, and by 58% of the social science, business, and systems research personnel in Survey 2. In both cases, the annual rate of professional productivity is over twice as large among the frequent (very often) participants than among the non- (seldom or never) participants.

As mentioned earlier, it is the looseness of many applied research contracts that allows non-formalized research. Although one might argue that the results of non-formalized research may be of questionable value to an applied research client who has sponsored research to answer a specific problem, many scientists maintain that non-formalized research is beneficial to the scientific interests of a broader national and international community. In many cases this activity may result in creative ideas that are also useful to, and appreciated by, client sponsors of research. Thus some opportunity for non-formalized research has even been considered, in a certain sense as a type of "scientific overhead" that a client expects to pay, even as he expects to pay an institutional overhead to maintain the facilities of his research contractor.

Moreover, opportunity to do some research on their own initiative in somewhat loosely structured applied research contracts may provide an important incentive to induce creative people to undertake applied research activities. It may be that more highly structured individuals, lacking the ability to break free from past thought patterns and to strike out in new dimensions, problem areas, and idea patterns, may seek more highly structured work situations. The evidence of most studies suggests that creative individuals seek less structured, freer situations.

Some individuals at Tiros and elsewhere advocate that research activities should be more highly structured--e.g., "management should decide clearly what the goals of the organization are, how they are going to reach these goals, and what they want us to do," or "research contracts should have detailed work statements, so that every step of the research is clearly defined in advance." Against these opinions is the counter-claim that a certain degree of vagueness in organizational objectives, in channels of authority and communication within an organization, and in research contract specifications, is actually a good thing.

## IX STATUS ADVANCEMENT

Entrepreneurship and non-formalized research are both more or less informal mechanisms used by research scientists to control their own futures within a research organization. Status advancement from what might be described as a "journeyman researcher" position to a semisupervisory or "working leader" position, on the other hand, represents a more commonly recognized formal means for acquiring more "legitimate" control over a working environment--being legitimate in the sense that it is recognized in a formal, institutionalized manner. This chapter includes a discussion of status advancement at Tiros and how it affects the adaptation of research scientists to the organization.

### Status Advancement at Tiros

Researchers at Tiros may not have become as "increasingly preoccupied with status seeking" as has the general population according to Vance Packard,\* but a considerable proportion are directly interested in advancement into management positions. In this regard, Table XXXIV shows that from one-fifth to two-fifths of the personnel surveyed at different levels expressed interest in advancement into higher levels in the Tiros management hierarchy. Almost one-third of the non-supervisory research personnel expressed such an interest, for example.

However, data in Table XXXIV also suggest that there just aren't enough supervisory positions available for non-supervisory researchers who want them. About 10% of the individuals at the lowest level of supervisory or semisupervisory positions--the program heads--are hired directly from outside Tiros, rather than promoted from within. But even if all could be promoted from within, there are only 43 program head positions currently available for the 122 non-supervisory research personnel who express a desire to move into supervisory positions. Or, as is shown in Table XXXIV, 32% of the personnel in Survey 3 desire a promotion into supervisory positions at Tiros, but only 11% of them could move into

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\* The concept of status seeking applied to modern Americans in general has been discussed in Packard, The Status Seekers.

Table XXXIV

DESIRES FOR PROMOTION INTO AND WITHIN MANAGERIAL  
POSITIONS AMONG PERSONNEL IN DIFFERENT LEVELS

	Survey 3		Survey 2	
	Proportion Indicating Desire for Promotion	Level- to-Level Ratio <sup>a</sup>	Proportion Indicating Desire for Promotion	Level- to-Level Ratio <sup>a</sup>
Research personnel-- non-supervisory	32%(246) <sup>b</sup>		32%(134)	
Program heads	36% (28)	11%	21% (29)	22%
Laboratory managers	40% (25)	89%		
Division and department administrators	33% (18)	72%	31% (13)	45%

- 
- a. The level-to-level ratio is defined as the ratio of the number of individuals at one level to the number of those at the immediately preceding level.
- b. Numbers of cases are shown in parentheses.

such positions at the next level if they were all filled by promotions from within.\* Similarly, 32% of the personnel in Survey 2 also desire promotion into supervisory positions, but only 22% of the Survey 2 personnel could move into such positions at the next level.

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\* Actually, in the Engineering and Systems A divisions constituting the Survey 3 population, some individuals move directly from non-supervisory research positions into laboratory management. However, even combining program head and laboratory manager opportunities for these individuals, it may still be seen that there are promotional opportunities for only 22% of the non-supervisory personnel, whereas 32% desire such promotions.



Therefore, it appears that the movement from a non-supervisory to a supervisory position provides the least opportunities in relation to the demand among Tiros personnel. At higher levels, Table XXXIV shows that opportunities for further promotion (assuming only promotions from within) apparently exceed the demand for such promotions.

This pattern of findings suggests another reason for the higher rate of turnover in the first few years of Tiros employment among research personnel who are ambitious for advancement into supervision. Eight percent and 19% of the Survey 3 and Survey 2 non-supervisory research personnel, respectively, indicated in this study that they intended to seek opportunities to move into managerial positions outside Tiros in the future.

The desire and opportunity for promotion from non-supervisory into supervisory positions is not distributed equally among all Tiros personnel, however. For example, Table XVIII (in Chapter V) indicates that researchers without advanced academic degrees were more likely than those with master's degrees, and much more likely than those with doctor's degrees, to express an interest in promotion into supervisory positions. Lacking more advanced technical backgrounds, these individuals seem to be more career-development oriented with regard to their work attitudes. Table XXXV, however, shows little difference in the distribution of academic degrees among the non-supervisory and supervisory personnel in Survey 2, but in Survey 3 the program heads were more likely to be Ph.D.'s. Those with no advanced degrees may possess the interest in assuming continuous supervisory responsibilities, but apparently they are more likely to lack what higher level research management may consider an important academic "face validity" qualification.

Table XXXV also shows that, as might be expected, the program heads are much less likely to be in the younger age category (under 30) than the non-supervisory personnel. At the other age extreme, however, there is an interesting difference between the Survey 3 and Survey 2 personnel. Among Survey 3 personnel, a higher proportion of older personnel (40 or over) are to be found than among the Survey 2 personnel. This may reflect a tendency for older business research personnel to move into business management rather than research management positions, whereas the reverse may be true of the "harder scientists" and research engineers found in Survey 3.

Also as might be expected, Table XXXV shows that fewer program heads are likely to be new people just brought into the organization from the

Table XXXV

**CHARACTERISTICS OF PROGRAM HEADS AND  
NON-SUPERVISORY RESEARCH PERSONNEL**

	Program Heads (N = 28) <sup>a</sup> (N = 29) <sup>b</sup>	Non-Supervisory Research Personnel (N = 246) (N = 134)
<b>Highest academic degree</b>		
Doctor's degree	36% <sup>a</sup> 21 <sup>b</sup>	18% 25
Master's degree	32 48	44 48
No advanced degree	32 31	38 28
<b>Age category</b>		
29 years or under	4 0	24 13
30 to 39 years	54 45	50 55
40 years or over	43 27	27 32
<b>Length of Tiros employment</b>		
Less than 1 year	4 14	19 16
From 1 to 5 years	46 31	50 56
Over 5 years	50 55	32 28

a. Upper numbers--Survey 3.

b. Lower numbers--Survey 2.

outside, and more are likely to be in a stable period of career development in the Tiros context (having over five years of service).\*

What difference does it make to be a program head at Tiros? We can now turn to a discussion of this question.

#### Consequences of Status Advancement

What many Tiros researchers would probably consider the most distinct advantage in being a program head would concern obtaining contract research opportunities in the area of one's research interest. Research contract opportunities come into Tiros in essentially three ways: (1) as open requests for proposals and competitive contract bids on a relatively specified research topic sent to a variety of prospective contractors considered qualified to bid by the contracting organization (usually a government agency in this case); (2) as a specific request to Tiros for a proposal on a given management problem amenable to a research solution (often from a commercial organization in this case); and (3) as a research idea proposed by a Tiros research scientist himself, for which he has solicited financial support from some interested client (frequently a government basic research support agency or a research foundation).

The third form of project initiation involves individual entrepreneurship, as discussed in Chapter VII. The other two forms of project initiation, however, usually involve higher management decisions in routing proposal requests from outside to what higher management officials consider to be the most qualified employee to handle this request, since these proposal requests usually come into the organization through the "front office." Management, in turn, ordinarily routes the proposal request to the program head who has the institutionalized and formalized responsibility to conduct research in the program area under which the proposed research appears, to management, to fall. This procedure, of course, gives program heads an advantage that non-program heads do not have to acquire and control projects in their recognized areas of interest, and it thereby provides a potent incentive for an individual researcher to become a program head.\*\*

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\* Different phases of career development, associated with length of service, are discussed in Chapter VI.

\*\* Difficulty in the operation of this procedure in routing proposal requests is frequent at Tiros, however, in that conflicts arise where two or more programs claiming interest in a proposal request disagree

According to individuals interviewed, however, program leadership has its disadvantages also. A program head is, on one hand, expected to conduct research himself--in this respect he is a senior researcher and more like a "working leader" in an industrial plant. At the same time, he is also normally a first-line supervisor with a small group of professional research personnel assigned to his program. He must therefore devote considerable time to administrative matters in addition to his research responsibilities. As a first-level supervisor, he must represent the research personnel in his program to higher management, and he must represent management policies to his subordinates. He is, in some ways, both a "union representative" and an administrator at the same time. In his special responsibilities to keep research clients happy, he is even more a "man in the middle" than the average foreman in industry. To be a buffer between diverse interests is the price a program head must pay to maintain the advantages of a supervisory position.

Nevertheless, this price does not seem to be too great for most program heads in a research organization like Tiros. Thus, Table XXXVI shows that a slightly higher proportion of program heads compared with non-supervisory research personnel at Tiros said that they are satisfied with their jobs in general, "taking everything into account." It may also be seen in Table XXXVI that there are slightly higher proportions of Tiros personnel in both categories, supervisory and non-supervisory, who are satisfied with their jobs in general than the proportions of supervisory and non-supervisory personnel responding similarly to the same question in a survey of seven western industrial organizations.

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on who should attend to it. In such cases, barring the ability of members of one program to convince management that the other program is obviously and demonstrably unqualified to handle the proposed research, an informal understanding of "finders--keepers" appears to resolve such conflicts in most cases. This is, of course, an entrepreneurial principle operating within the organization.

Table XXXVI

GENERAL JOB SATISFACTION AMONG SUPERVISORY  
AND NON-SUPERVISORY RESEARCH PERSONNEL AT TIROS  
AND IN SEVEN WESTERN INDUSTRIAL ORGANIZATIONS<sup>a</sup>

	Percentage "Satisfied" with Job <u>in General</u>
At Tiros	
Program heads (N = 57)	74%
Non-supervisory research personnel (N = 380)	70
In Seven Western Industrial Organizations <sup>a</sup>	
Supervisors (N = 202)	70
Non-supervisory professional personnel (N = 224)	60

- 
- a. From a survey study of seven western industrial organizations conducted by Stanford Research Institute in 1961.

Table XXXVII provides more specific responses on the degree to which being a program head is associated with a decrease in the discrepancy between desired and achieved working conditions. Data are shown in this table for three items of particular concern to Tiros research personnel--"opportunity to keep up-to-date on new scientific developments," "having sufficient funds to conduct preferred research," and "having a large degree of freedom in project assignments." These data indicate that for all three items there was less discrepancy between desires and achievements for program heads than for non-supervisory research personnel.

The third item in this series was the one for which there was the greatest decrease in desire-experience discrepancy for program heads, however. Findings for this item indicate that program heads are, in fact, much more likely to experience a large degree of freedom in project assignments than are non-supervisory personnel--in part, at least, because of advantages in proposal routing, as described earlier.

Table XXXVII

DEGREE OF IMPORTANCE ATTACHED TO VARIOUS WORKING CONDITIONS AND  
DEGREE OF EXPERIENCE OF THESE CONDITIONS AMONG PROGRAM HEADS  
AND NON-SUPERVISORY RESEARCH PERSONNEL

	(A) Employee Importance Index <sup>a</sup>	(B) Employee Experience Index <sup>b</sup>	Discrepancy (A) - (B)
Opportunity to keep up-to-date on new scientific developments in my field			
Program head	165 <sup>c</sup> 156 <sup>d</sup>	101 79	64 77
Non-supervisory researcher	160 165	92 67	68 98
Having sufficient funds to conduct the kind of research I want to do			
Program head	139 152	68 69	71 83
Non-supervisory researcher	138 136	53 40	85 96
Having a large degree of free- dom in selecting research as- signments			
Program head	140 155	100 134	40 21
Non-supervisory researcher	136 129	61 33	75 96

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- a. For calculation of these indexes see footnote b in Table III (index can vary between 0 and 200).  
b. For calculation of these indexes see footnote b in Table VI (index can vary between -100 and +200).  
c. Upper numbers--Survey 3.  
d. Lower numbers--Survey 2.

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A final question may be asked about the relation between program leadership and professional productivity. Table XXXVIII shows that, as might be expected, program heads have a considerably higher rate of productivity of technical publications than non-supervisory research personnel at Tiros. This finding, of course, is consistent with findings reported earlier in chapters VII and VIII, that research entrepreneurs and research bootleggers also tend to have higher rates of professional productivity than those who do not make as full use of these mechanisms. Each mechanism--formal status advancement, entrepreneurship, and bootlegging--provide resources (i.e., access especially to project funds, but also to research ideas and to supporting personnel) necessary for successful and sustained publication efforts. In addition, willing participation in any or all of these mechanisms is probably indicative of the general achievement motivation that is practically essential for one to continue the sustained effort necessary to write technical publications in the face of competing time deadline pressures at Tiros.

Table XXXVIII

PROFESSIONAL PRODUCTIVITY AMONG PROGRAM HEADS  
AND NON-SUPERVISORY RESEARCH PERSONNEL

	Program Heads (N = 28) <sup>a</sup> (N = 29) <sup>b</sup>	Non-supervisory Researchers (N = 246) (N = 134)
Have produced 1 or more professional publications based upon Tiros research	54% <sup>a</sup> 44% <sup>b</sup>	35% 21%
Have produced 4 or more professional publications based upon Tiros research	18% 24%	7% 2%
Average number of years of Tiros employment to produce 1 publication	3.6 3.4	4.8 9.8

a. Upper numbers--Survey 3.

b. Lower numbers--Survey 2.



It is also of interest to note that the rate of productivity (shown in terms of average years of Tiro's employment required to produce one publication) is almost the same for mostly-engineering research program heads in Survey 3 and mostly-business research program heads in Survey 2, while there is a large discrepancy between the rates of professional productivity of non-supervisory research personnel in the two survey groups.

It is easy to attribute differences in professional productivity between business research and engineering research personnel to differences in the nature of the professions themselves--perhaps one profession tends to emphasize the value of publications more than the other. However, such a conclusion would have to be modified, at least, if the pattern of data shown in Table XXXVIII can be found in other organizational case studies. These data are in accord with the proposition that when an organization provides resources from which publications can be derived (e.g., through making research personnel into program heads and allowing them the privileged access to funding sources, etc. that program heads normally enjoy), then individuals from different professional backgrounds approach an equal rate of productivity.

## X SUMMARY AND CONCLUSIONS

### Managerial Requirements

Like other complex organizations, Tiros may be viewed as a coalition of interests and of interest groups--in this case a coalition of research interests within the context of the research industry. This is a very dynamic and highly competitive industry. Within this dynamic and competitive context, activity at Tiros tends to be oriented toward three goals that are in delicate counterbalance: (1) to provide research services meeting the immediate needs of commercial and government clients; (2) to conduct fundamental research of high technical quality contributing to general scientific knowledge; and (3) to provide for the survival and controlled growth of Tiros itself as an institution.

These three categories of goals are institutionally supported within the organization by the formal organizational structure. Over time, however, it appears that institutional goals have come to predominate, followed by technical considerations, with client service goals closely following in importance. Nevertheless, the fact that no one of these goals has completely overridden the others has probably facilitated the flexibility and adaptability of Tiros.

These goals become translated into specific managerial requirements imposed upon research scientists at Tiros. These requirements relate to a broad range of activities, including: (1) developmental processes (e.g., acquiring the funding, ideas, and personnel necessary to initiate and sustain research activities); (2) production processes (actually conducting research, data collection, analysis, interpretation, etc.); (3) transmission processes (e.g., writing reports and publications and providing consultation on implementation); and (4) administrative processes (e.g., assigning research responsibilities). The managerial requirements that apparently receive the most emphasis at Tiros--aside from the obviously important research production activities--are the requirements for researchers to keep up-to-date on new scientific developments in their fields of study, to publish research findings in addition to specific client reports, and to exercise individual initiative in developing research ideas and accepting research assignments.

### Employee Perspectives

Discrepancies between the aforementioned managerial requirements and employee interests were largest for two items: (1) Tiros management tended to place more emphasis upon the value of research publication than did the Tiros research personnel; and (2) although management emphasis upon the responsibility of researchers to seek client support for their individual research interests was not very high, it was considerably stronger than among the researchers themselves.

Among the Tiros research personnel, opportunities to do "challenging research," to keep up-to-date on new scientific developments, to have adequate technical assistance, an adequate salary, sufficient research funding, opportunity to do basic research, being employed by a respected organization, having freedom to choose research assignments, and opportunity to do applied research were rated as important to higher proportions of research personnel, in that order. Among these items, Tiros researchers were more likely to indicate that they did not have the amount of research funding, the degree of freedom in project assignments, and the opportunity to keep in touch with new scientific developments that they desire to have, in that order. These deficiencies cannot be attributed to a lack of emphasis on these items by Tiros management, but instead appear to reflect difficulties and limitations inherent in the research funding structure of an independent research organization like Tiros. Paradoxically, however, many Tiros researchers apparently do not recognize that more attention to individual entrepreneurial activity might remedy, in part at least, these apparent structural limitations.

These problems, therefore, appear to arise from three kinds of conflicts at Tiros: (1) management-employee conflict problems; (2) structural conflict problems; and (3) means-end conflict problems. These kinds of problems are probably not unique to Tiros, but are also found in other organizational contexts.

### Incentives

The use of incentives represents one managerial mechanism for reducing conflicts within an organization and for bringing individual behavior into alignment with managerial requirements. As indicated previously, Tiros management is especially concerned with increasing the professional productivity of its employees in terms of the output of technical publications. Management is also concerned with maximizing general job satisfaction among the research personnel, since general job satisfaction is related to employee turnover.

Four general types of incentives are available to management at Tiros: (1) items related to the nature of the work performed; (2) resources for the work; (3) rewards for work accomplishment; and (4) career development opportunities. After examining the effects of specific incentives within these categories, it was found that only one specific item--providing freedom of choice in research assignments--apparently contributes to both professional productivity and general job satisfaction. In addition, perceived adequacy of research funds to support individual interests and opportunity for promotion into management apparently contribute directly to general job satisfaction, but not necessarily to professional productivity. In contrast, opportunity to do basic research and opportunity to be a project leader apparently contribute directly to professional productivity, but not necessarily to general job satisfaction. Other items, such as salary, do not appear to contribute either to general job satisfaction or to professional productivity. It appears that those items that are most adequately provided in the Tiros context, such as salaries, tend to lose their potency as incentives toward further productivity or satisfaction.

#### Recruitment and Displacement

Recruitment and displacement, by changing the mix of types of employees, represents another management mechanism for alleviating organizational conflicts. Authorities at Tiros recognize that competent and creative researchers are its most important asset. Therefore, careful recruitment is perhaps the most-used adaptation mechanism from the management standpoint at Tiros. Displacement by means of formal discharge is seldom used at Tiros.

The larger number of new hires at Tiros are recruited from private industrial or commercial organizations, with a smaller number coming from academic institutions and still smaller proportions coming from a variety of other governmental and private agencies. There is some indication that new hires from academic institutions, compared with those from industry, are slightly more likely to be entrepreneurial in their interest in selling research ideas to prospective clients, to be research project leaders, and to produce technical publications, but are slightly less likely to be satisfied with their jobs in general at Tiros.

There are about twice as many individuals at Tiros with master's degrees as with doctor's degrees. Those with doctor's degrees appear to be more science-oriented in their adaptations to Tiros, producing more professional publications, for example, than other research

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scientists of less educational background. Those with master's degrees tend to be more application-oriented in their interests in specific problem-solving research activities, and those without advanced degrees express a career-development-oriented pattern of concern with job security.

There are more Tiros employees in the 30-39 age category than in other categories, and these employees appear to be most active in their publications effort and in most of their research activities.

### Socialization

Socialization constitutes the third mechanism to relieve organizational conflicts from a managerial standpoint. Much of this process is unconscious, acting over time to change attitudes and behavior patterns of individuals and to bring them into line with organizational goals and requirements. Socialization at Tiros tends to follow three stages of career development: (1) an initial period of from six months to one year, characterized by an especially high degree of organizational identification and job satisfaction on the part of new employees; (2) an adjustment period of from one to about four years, characterized by an especially low degree of organizational identification and job satisfaction; and (3) a stable period from about the fifth year onward, characterized by at least a tentative decision to continue in the organization and by a growing commitment to it. This pattern of career development within an organizational context appears to involve two significant career decisions: (1) the decision to join the organization and (2) the later decision to remain in the organization.

Although professional productivity tends to increase up to about ten years of service at Tiros, the desire to publish and to be entrepreneurial in selling research ideas to prospective clients tends to decrease eventually among Tiros researchers. This decrease does not occur among the minority of Tiros employees recruited from academic institutions. For most of its research personnel, however, it appears that Tiros management has not been able to exploit completely the mechanism of socialization by using incentives effectively over time of employment.

### Entrepreneurship

Research entrepreneurship is a mechanism at the disposal of individuals to protect themselves from certain forms of managerial influence

within organizational contexts. This process may be described as exerting individual initiative to contact prospective research clients outside the organization and to seek their financial support for research projects in the individual's areas of interest. Entrepreneurial activity differs markedly from bureaucratic patterns of behavior, even though both may be found within the same organizational context. Tiros is fundamentally a bureaucratic type of organization in its administrative and service departments but is essentially entrepreneurial in its research departments.

Four kinds of research entrepreneurs have been identified at Tiros: (1) satisfied entrepreneurs--those who indicate that "selling research ideas to prospective clients" is important to them personally and that they have had opportunity to do this at Tiros; (2) frustrated entrepreneurs--those who say that selling is important to them but that they have not had adequate opportunity to do it at Tiros; (3) reluctant entrepreneurs--those who say that they have had ample opportunity to sell but that it is not important to them; and (4) non-entrepreneurs--those who report no opportunity to sell and no importance attached to it. Satisfied and reluctant entrepreneurs outnumber those in the other categories at Tiros.

Satisfied and reluctant entrepreneurs were more likely to say that they have been able to achieve the things that are important to them in their work while at Tiros, such as keeping in touch with new scientific developments, having sufficient funds to support their research interests, and having freedom in project assignments. Satisfied entrepreneurs, followed closely by reluctant entrepreneurs, also had the highest rate of professional productivity. Research entrepreneurs may be said to be the doers in practically all aspects of the research activities that underlie the survival and growth of an organization like Tiros.

#### Non-formalized Research

A second mechanism used by individuals to develop their own interests within research organizations is described as non-formalized research. As used here, non-formalized research refers to the informal development of basic research ideas in areas of interest to the researcher within ongoing applied research contracts, rather than an attempt to initiate new research projects under the direct control of the individual researcher. Non-formalized research is much more likely to occur in large research contracts, where there may be more flexibility in detailed project specifications, less pressure from project deadlines, and thus more

opportunity to engage in non-formalized research. Also there is a strong indication that there is more incentive to participate in this activity and that it is more likely to occur where research personnel feel themselves to be most lacking in adequate research funds to support their own research interests.

Non-formalized research is also markedly related to professional productivity--participants have a much higher rate of productivity of technical publications than do non-participants.

#### Status Advancement

Moving from a non-supervisory to a semisupervisory program-head position represents a third mechanism for individuals to gain a greater measure of control over their organizational surroundings. This is a more commonly recognized adaptation mechanism for individuals, and about one-third of the Tiros non-supervisory research personnel express an interest in moving into supervisory positions, although there are not enough positions to accommodate these desires.

Probably the most distinct advantage to being a program head at Tiros is to have a more systematic access to research contract opportunities than is had by a non-supervisory research scientist at Tiros. The opportunities provided by the program-head position are associated with the likelihood of greater job satisfaction, less discrepancy between desires and experiences with regard to keeping in touch on new scientific developments, having sufficient funds to conduct preferred research, and having a large degree of freedom in project assignments. These conditions, in turn, are all associated again with a higher rate of professional productivity among program heads than among non-supervisory research personnel at Tiros.

#### Conclusions

The findings of this study indicate that status advancement, along with entrepreneurship and non-formalized research, serve as adaptation mechanisms that can assist individual researchers to reach their goals and pursue their particular interests in organized research environments. Conversely, the use of incentives, recruitment and displacement, and socialization can all serve as more or less effectively utilized mechanisms for management to attempt to bring individual interests and activities into accord with organizational goals.

There is a dynamic at work in the interaction of these mechanisms. Management can be somewhat effective in the degree to which it can reshape individual interests in accord with organizational requirements, but it is never completely effective. Human beings--at least mature adults--are not entirely plastic; they tend to form interests, attitudes, and habit patterns that are not easily erased. As they seek ways to express these interests within a complex organizational context, they may first engage in more or less surreptitious means to express and sustain their interests (non-formalized research), may then seek external support for further development of these interests (entrepreneurship), and, finally, move into the hierarchy of the organization (status advancement) where their ideas can be imposed upon an organization, or at least a segment of it, by means of formal and legitimate management decisions.

A major theme of this case study has been the need for free individual initiative with regard to research undertakings. Providing opportunity for the exercise of freedom in the choice of research assignments is the only incentive that is clearly linked both to general job satisfaction and to professional productivity among research personnel at Tiros. Most Tiros research personnel want this kind of freedom, and their management also recognizes its desirability.

However, a research management cannot, by itself, provide a wide range of choice in research opportunities within the structural constraints of a contract research organization. Researchers must work on the funded research projects that are available to them. At the same time, researchers can do something about this situation. They can exercise entrepreneurship to initiate support for projects in their own areas of interest, they can engage in non-formalized research to express their own interests within research contracts oriented primarily toward other interests, and they can perhaps eventually advance in status to program-head positions where they can gain institutional recognition of certain areas of research investigation.

In other words, it is largely up to individuals to create their own conditions of freedom within a research organization like Tiros. Individual researchers' initiative must supplement managerial initiative for a research organization to achieve its goals most effectively and efficiently.

Questions remain as to the degree to which the incentive of freedom of research assignments is also linked to general job satisfaction and to professional productivity in other kinds of research organizations; the relative importance of other incentives of other contexts; the degree



of discrepancy between managerial requirements and employee perspectives in these contexts; the pattern and consequences of recruitment, displacement, and socialization in other organizations; the way in which entrepreneurship, non-formalized research, and status advancement may be exercised by research personnel in other organizations; and the degree to which other adaptation mechanisms of similar, or perhaps even greater, importance may be found elsewhere. In these matters, a government laboratory may differ considerably from an industrial research department, and both may differ from an academic research institution, while all three could differ from an independent research organization like Tiros. These will be among the questions to be explored in further research.

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